Carrier
TRANSICOLD

Trailer Refrigeration Unit

Genesis TM900
Genesis TM1000
Multi-Temp

Prior to Serial Number HAY90594029

OPERATION AND SERVICE

62-10022-01 Change 03/04

Carrier

TRANSICOLD

OPERATION AND SERVICE MANUAL

TRAILER REFRIGERATION UNIT

Genesis TM900
Genesis TM1000
Multi-Temp

Prior to Serial Number HAY90594029

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Carrier
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SECTION 1
DESCRIPTION

1.1 INTRODUCTION

Table 1-1. Model Chart

Models	Refrigerant				Compressor	Engine	Engine Speed rpm
	R-22		R-404A				
	LB	KG	LB	KG			
Genesis TM900							
NDA93–––N	–	–	28	12.7	05G 37 cfm	CT4-134-TV or CT4-134-DI	1700
NDA94–––N	28	12.7	–	–			
Genesis TM1000							
NDA93–––W	–	–	28	12.7	05G 41 cfm	CT4-134-TV or CT4-134-DI	1700
NDA94–––W	28	12.7	–	–			

EVAPORATORS			
Evaporator Models	**Lane Size**	**Discharge**	**Number of Fans**
MMD 1100-2	1/2	Double	2
MMD 1100-3	1/2	Double	3
MMD 2200-4	1	Double	4
MMS 1100-2	1/2	Single	2
MMS 2200-4	1	Single	4

a. System

The Genesis TM900 and TM1000 Multi-Temp, multiple compartment refrigeration systems offer the versatility of two or three compartment temperature control. The Multi-Temp allows the shipper to ship frozen and perishable commodities in the same load under separate refrigeration control. The Genesis Multi-Temp allows any compartment to be any temperature.

The unit also is equipped with a 5-kilowatt, single phase, 240 v-ac generator in the nosemount to power the electric heaters and fans in the evaporators.

Also mounted to the left of the generator is a high voltage box. In the high voltage box are two 20 amp fuses and high voltage relay(s).

This manual contains Operating Data, Electrical Data and Service Instructions for the refrigeration units listed in Table 1-1. Table 1-1 also charts some significant differences between these models.

WARNING

Beware of V-belts and belt driven components as the unit may start automatically. The unit operates on high voltage. Before servicing unit, make sure the Run - Stop switch is in the STOP position. Also disconnect the negative battery cable.

b. Model NDA

The unit is a one piece, self-contained, fully charged, pre-wired, refrigeration/heating "nosemount" diesel powered unit for use on insulated trailers to maintain cargo temperatures within very close limits. The model/serial number plate is located inside of the unit on the rear frame as shown in Figure 1-3.

The evaporator fits into a rectangular opening in the upper portion of the trailer front wall. When installed, the evaporator section is located inside the trailer; and the condensing section is outside and on the front of the trailer.

The condensing unit consists of an engine–compressor drive package, condenser fan, condenser coil, radiator coil, control panel, relay module, refrigerant controls, piping, wiring, defrost air switch, and associated components.

The evaporator assembly consists of an evaporator coil, evaporator fan, expansion valve, two defrost thermostats (termination switches) and 2 high temperature safety switches. The location of the thermostats are shown in Figure 1-6. The return air sensor is also shown in Figure 1-6.

Heating for the nosement is accomplished by circulating hot gas directly from the compressor to the evaporator coil. Four electric solenoid valves control the refrigerant circuit to operate the heating/cooling system. Also heating can be accomplished by electric heat: 2 kw of heat in each compartment for a 3 compartment system or 4 kw of heat in each compartment for a 2 compartment system.

On the host unit automatic evaporator coil defrosting is initiated by either sensing the air pressure drop across the coil with a differential air switch or with the defrost timer in the microprocessor. Remote evaporators have a defrost timer.

The control door and relay module include manual switches, microprocessor, ammeter, fuses, and associated wiring. Also, the unit is equipped with a remote light bar as standard equipment. It is mounted separately on the front roadside corner of the trailer.

The temperature controller is a microprocessor solid state controller (Refer to section 1.11). Once the controller is set at the desired temperature, the unit will operate automatically to maintain the desired temperature within very close limits. The control system automatically selects cooling or heating as necessary to maintain the desired temperature within the trailer.

The refrigeration compressor used (Refer to Table 1-1) is equipped with Varipowr as standard equipment. Varipowr is used as a compressor capacity control to unload the compressor during periods of reduced loads. This provides closer temperature control, reduces potential for top freezing and reduces power required to operate the compressor; thus reducing fuel consumption.

The engine (Refer to Table 1-1) gives excellent fuel economy and has easy starting characteristics. The engine is equipped with spin-on lube oil and fuel oil filters for easier filter changes.

NOTE

Throughout this manual, whenever the "left" or "right" hand side of the engine is referred to, it is the side as viewed from the flywheel end of the engine.

The diesel engine drives the compressor directly through a nylon drive gear and adapter. The adapter also includes a V-belt sheave which drives the clutch/gearbox. The condenser/evaporator fan shaft is driven with a V-belt from the clutch/gearbox. A separate V-belt from the clutch/gearbox drives the alternator.

Electrical power for the control system and for charging the batteries is provided by the 12 vdc alternator.

Also the auto start/stop feature is standard equipment.

The auto start/stop operation provides automatic cycling of the diesel engine, which in turn offers an energy efficient alternative to continuous operation of the engine with control of temperature by alternate cooling and heating of the supply air (evaporator outlet air).

c. Remote Evaporators

The compartments of the Multi-Temp system are equipped with separate evaporators.

For Multi-Temp applications, single air discharge and double air discharge evaporators are available. The evaporators are different in size, capacity and number of fans, but all work on the same principle and use the same single-phase 50Hz/60Hz fan assembly. The 230v 1 kw electrical heaters vary in length according to the evaporators and number of compartments. (see Figure 1-2)

The evaporator is constructed with aluminium profiles designed to meet the specific requirements of the transport industry. The bottom section of the evaporator is hinged to allow easy access to both the electrical and refrigeration hardware.

Inside the evaporator housing are one or more of the following :

240 Volt Single phase backward curved impeller which supplies high air volumes at low noise levels; expansion valve; check valve; 12V liquid line solenoid; 12V water drain heater; electrical heater element; sensor (defrost termination sensor); safety heating thermostats.

d. Compartment Control Box (Optional)

The compartments of the Multi-Temp system maybe equipped with remote mounted control box (see Figure 1-1). This control box has a system on/off button and compartment on/off buttons. The remote mounted control box displays current compartment temperature and setpoint.

Set setpoint by pressing the up or down arrows as required. The control box can be locked (no buttons active) by pushing the Carrier oval once. This will activate the LED next to the lock picture. To unlock the control box press the Carrier oval for 10 seconds. When the compartment control box is locked the temperature setting and manual defrost can still be altered with microprocessor panel.

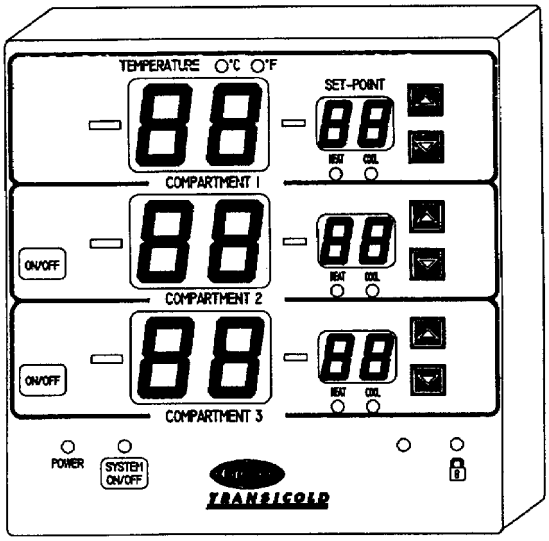
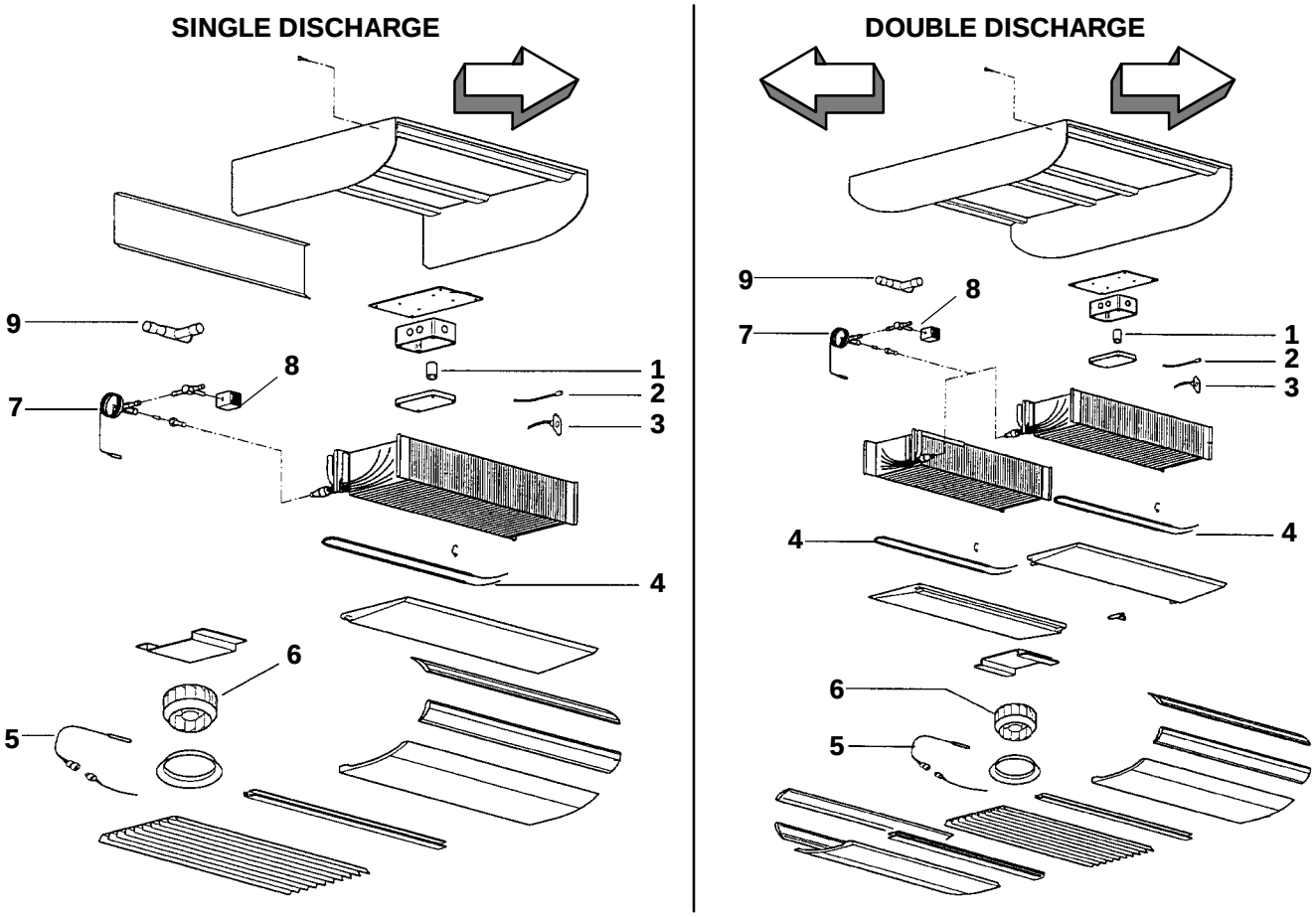
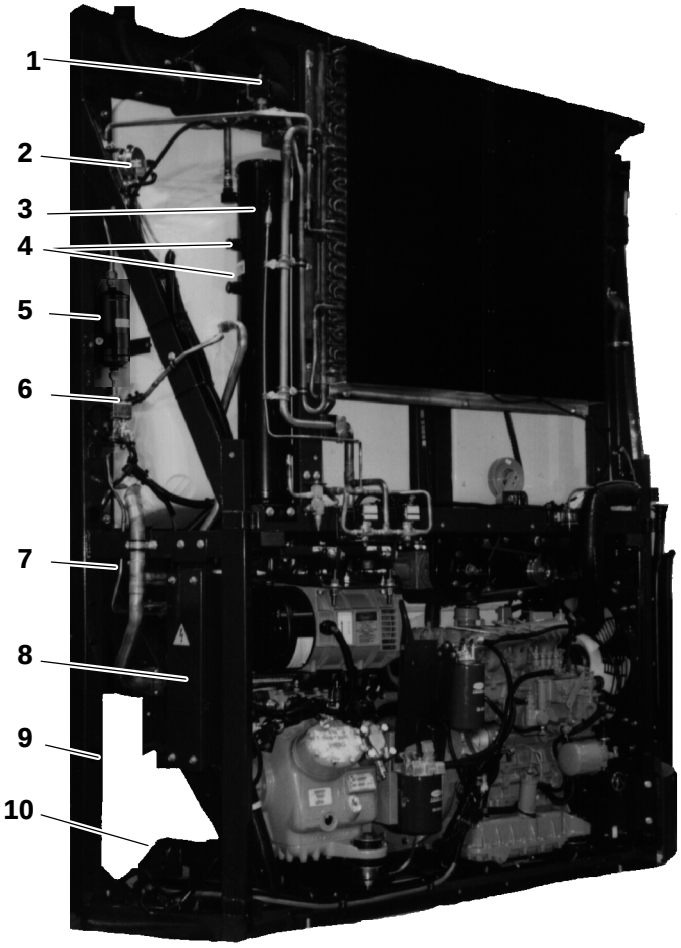


Figure 1-1. Compartment Control Box



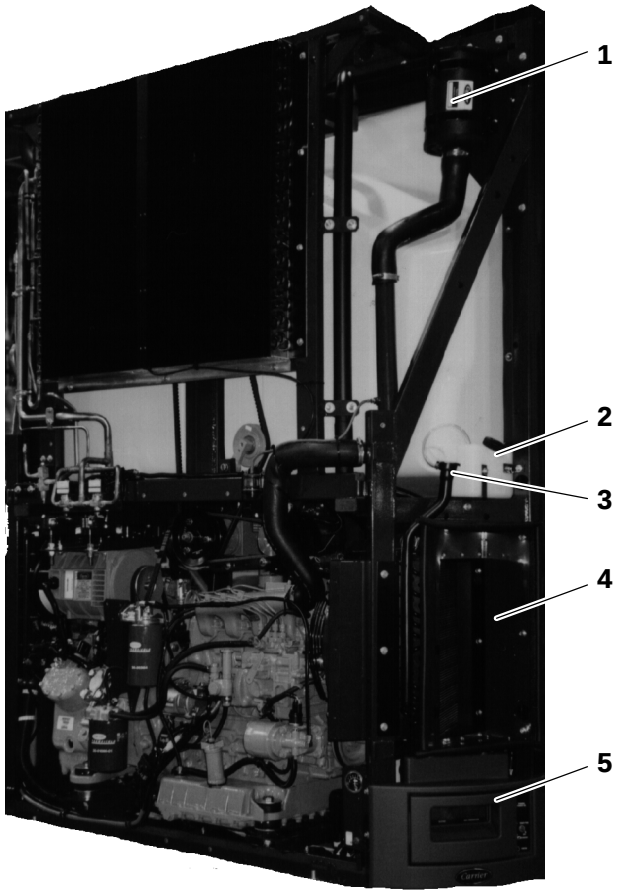
1. Capacitor
2. Defrost Terminal Sensor
3. High Temperature Klixon
4. Heaters
5. Thermostat Sensor
6. Evaporator Fan & Motor
7. Expansion Valve
8. Liquid Solenoid Valve (LSV)
9. Check Valve

Figure 1-2. Remote Evaporator



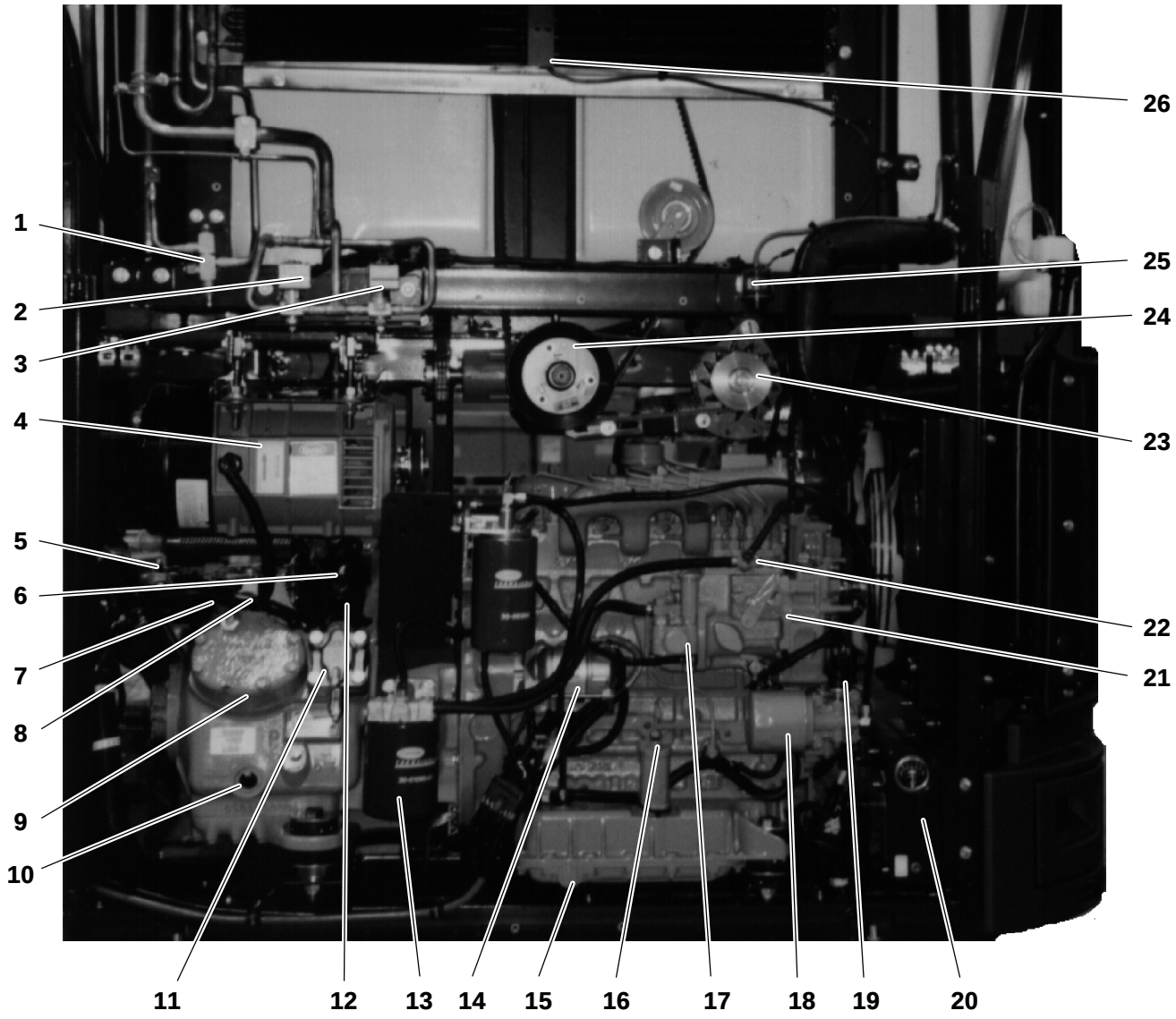
1. Condenser Pressure Control Solenoid Valve (SV-1)
2. Defrost Air Switch
3. Receiver
4. Receiver Sight Glass
5. Filter-Drier
6. Liquid Line Solenoid Valve (SV-2)
7. Quench Valve – R-22 Only
8. High Voltage Control Box – See Figure 1-8
9. Model/Serial No. Location
10. Battery Location

Figure 1-3. Curbside



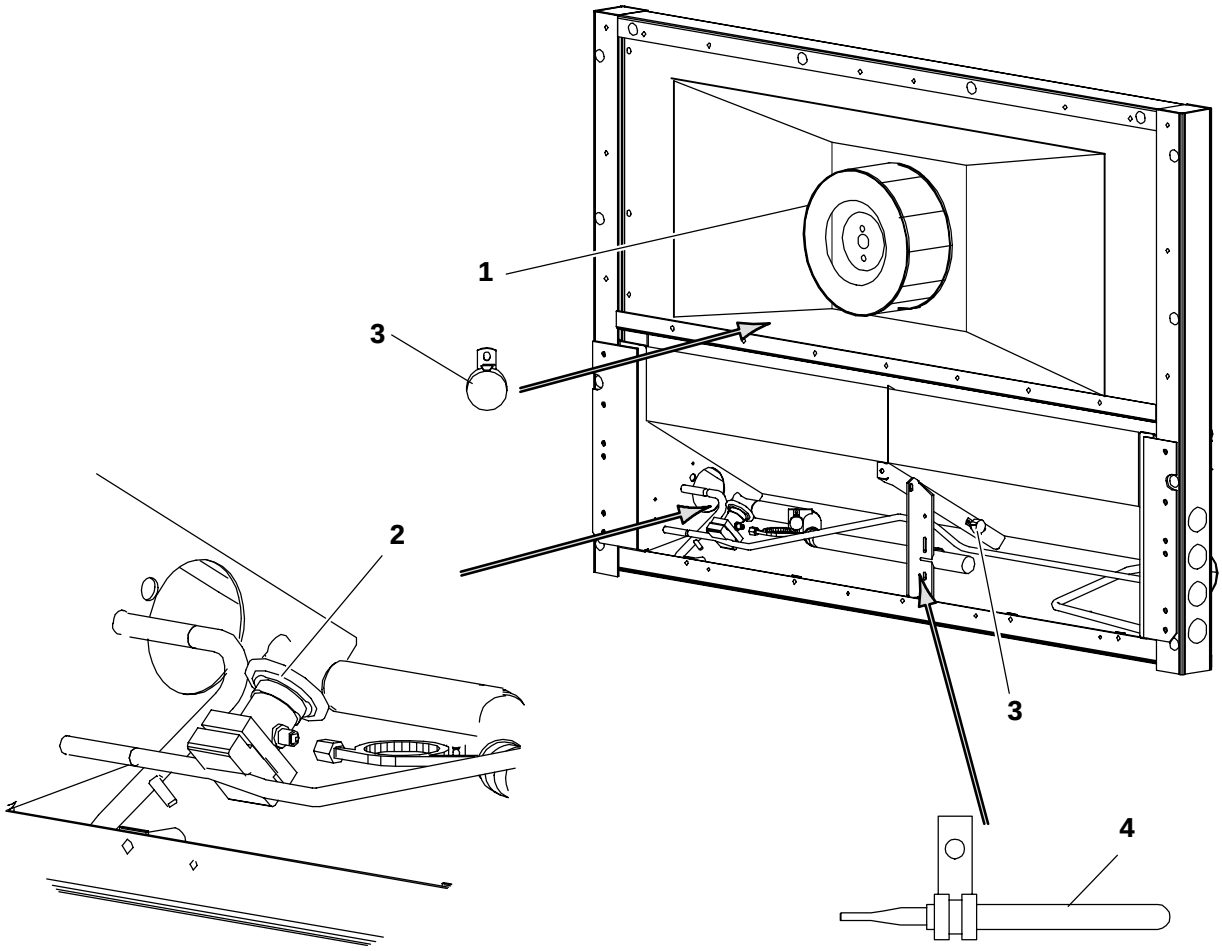
1. Engine Air Cleaner
2. Radiator Overflow Reservoir
3. Radiator Fill Neck
4. Radiator
5. Control Box Door – See Figure 1-7

Figure 1-4. Roadside



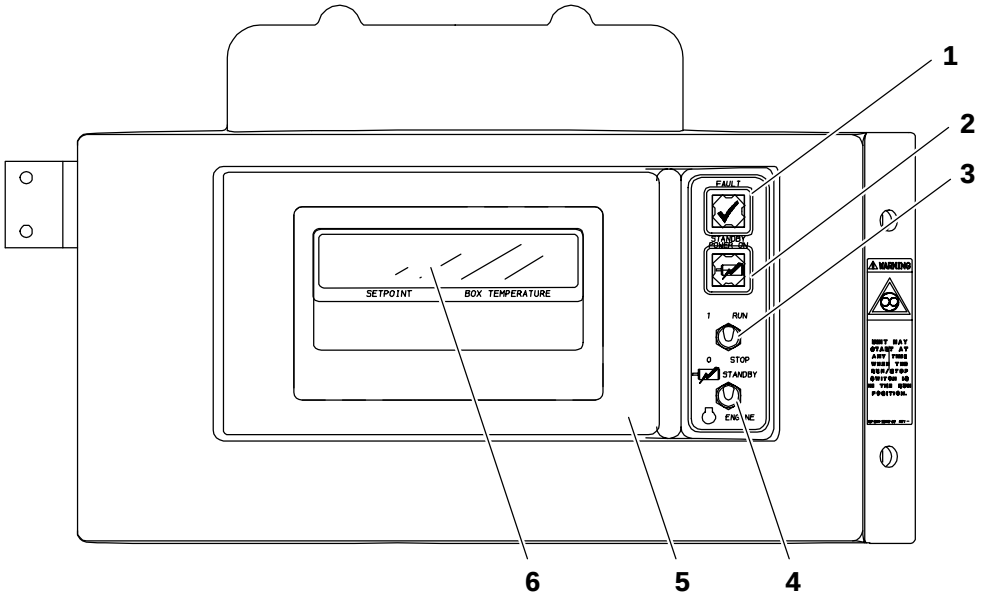
1. King Valve
2. Hot Gas Solenoid Valve (SV-3)
3. Hot Gas Solenoid Valve (SV-4)
4. Generator 5kw
5. Discharge Service Valve
6. Compressor Discharge Temperature Sensor (CDT)
7. Unloader Solenoid Valve
8. High Pressure Cutout Switch (HP-1) and Head Pressure Control Switch (HP-2)
9. Compressor – 05G
10. Compressor Sight Glass
11. Suction Service Valve
12. Suction Pressure Transducer (SPT)
13. Fuel Filter
14. Starter Motor
15. Oil Drain
16. Lube Oil Fill
17. Mechanical Fuel Pump
18. Lube Oil Filter
19. Oil Pressure Switch
20. Relay Module – See Figure 1-9
21. Injection Pump
22. Fuel Bleed Valve
23. Alternator and Regulator
24. Clutch/Gearbox
25. Air Cleaner Service Indicator
26. Ambient Temperature Sensor (ATS)

Figure 1-5. Front View



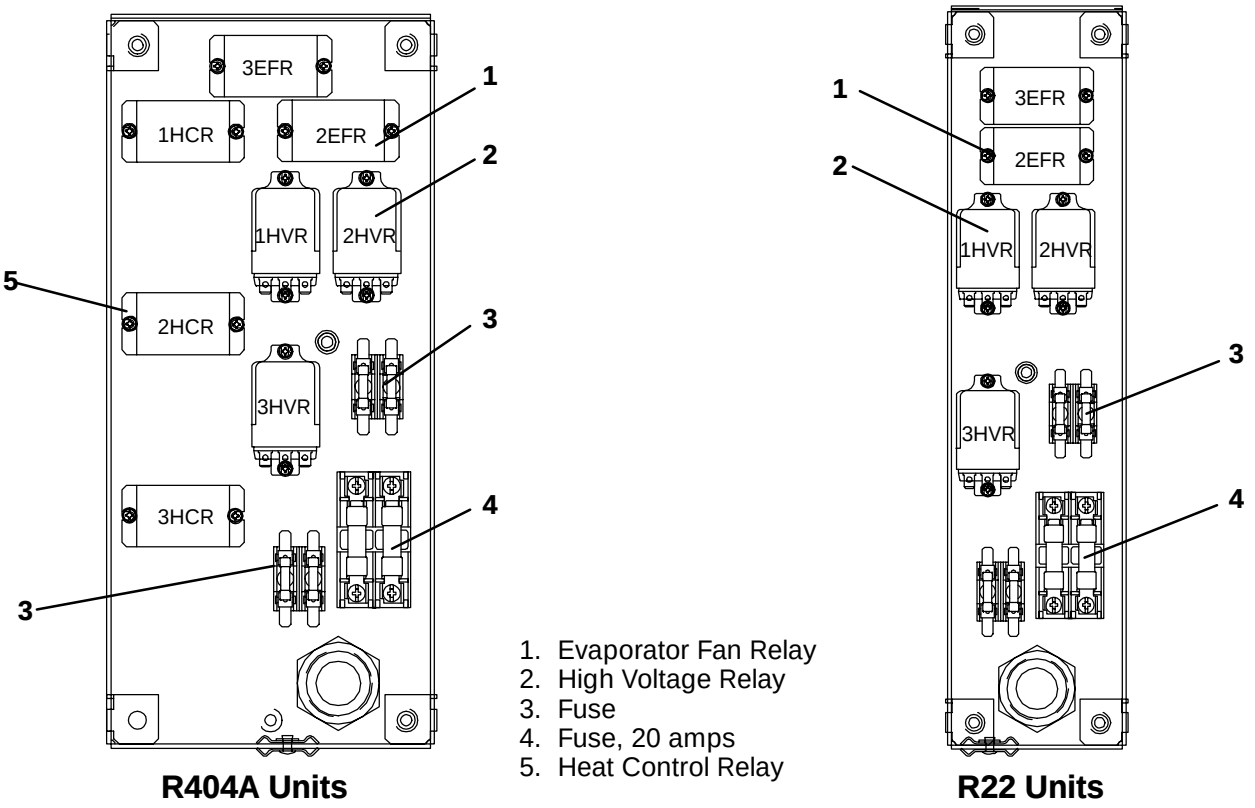
1. Evaporator Fan
2. Expansion Valve
3. Defrost Termination Thermostats
4. Return Air Sensor

Figure 1-6. Evaporator Section – Panels and Grille Removed



1. Fault Light
2. Standby Power Light (PL) – Model NDM
3. Run-Stop Switch
4. Selector Switch (SSW) – Model NDM
5. Keypad Door
6. Microprocessor Control Panel (See Figure 1-14)

Figure 1-7. Control Box Door

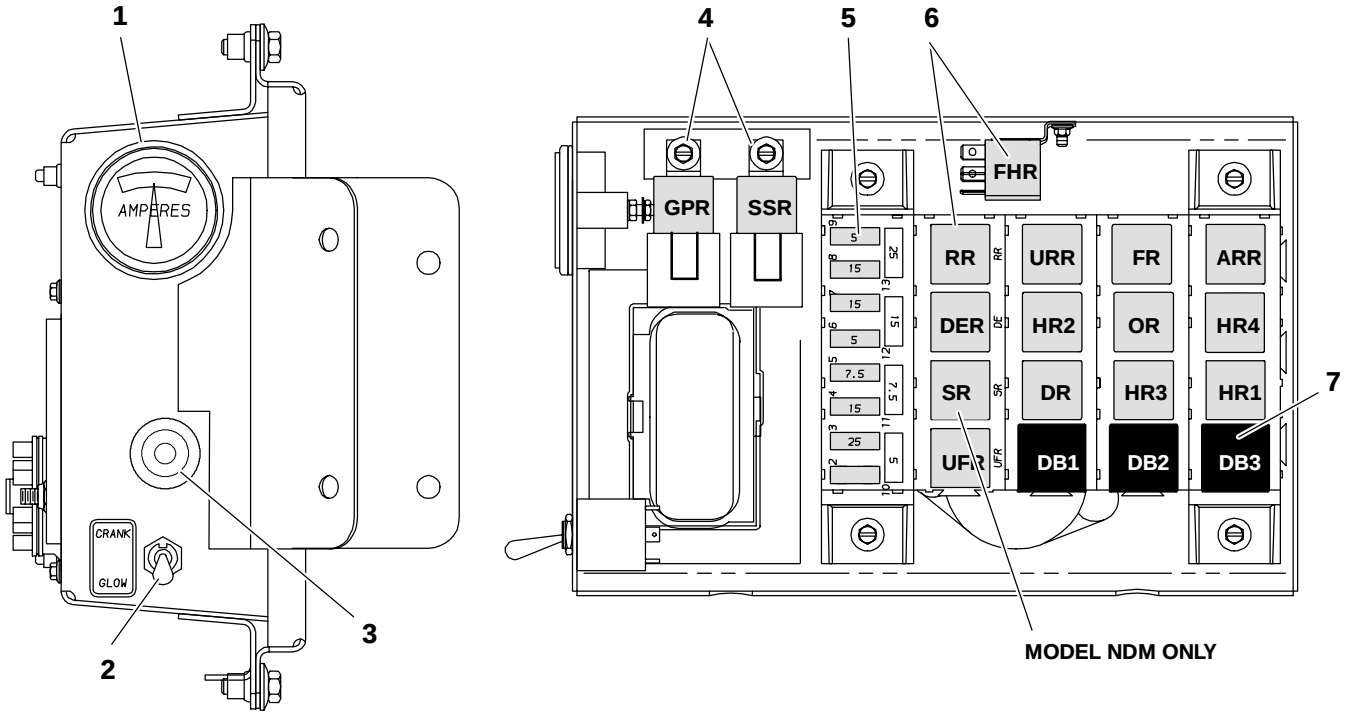


R404A Units

1. Evaporator Fan Relay
2. High Voltage Relay
3. Fuse
4. Fuse, 20 amps
5. Heat Control Relay

R22 Units

Figure 1-8. High Voltage Control Box



1. Ammeter
2. Manual Glow/Crank Switch
3. Buzzer
4. Starter Solenoid Relay (SSR) and Glow Plug Relay (GPR)
5. Fuses - F1 (80A), F3 (25A), F4 (15A), F5 (7.5A) F6, F7, F8 (15A), F9 (5A)
6. Relays, Run (RR), Diesel Electric (DER), Unloader Front (UFR), Unloader Rear (URR), Heat (HR1, HR2, HR3 & HR4), Defrost (DR), Fault (FR), Out-of-Range (OR), Auto Restart (ARR), Fuel Heater (FHR)
7. Diode, Block (DB1, DB2 & DB3)

Figure 1-9. Relay Module

1.2 ENGINE DATA

Engine Models	CT4-134TV (V2203TV)	CT4-134DI (V2203DI)
Displacement	2.2 liters (134 in^3)	2.2 liters (134 in^3)
No. Cylinders	4	4
Horsepower	34 hp @1900 rpm 25 hp @ 1350 rpm	33 hp @1900 rpm
Weight	189.5 kg (417.8 lbs)	
Coolant Capacity	7.6 liters (2 gallons)	
Thermostat	Starts to Open 157 to 162_F (69 to 72_C) Fully Open 185_F (85_C)	
Oil Capacity with Filter	14 liters (15 quarts)	
Injection Setting	140 to 150 kg/cm^2 (1991 to 2133 psi)	
Fuel	Winter: Diesel No. 1 Summer: Diesel No. 2	
Firing Order	1−3−4−2	1−3−4−2
Glow Plug Amperage	7.0 amps per plug at 10.5 vdc (nominal)	
Valve Clearance (Cold) (Intake and Exhaust)	0.0071 to 0.0087 inch (0.18 to 0.22 mm)	

a. Lubrication System

Oil Pressure:

40 to 60 psig (2.8 to 4.2 kg/cm@)

Oil Pressure Safety Switch Setting Closes:

15 (¦ 3) psig (1.05 kg/cm@)

Lube Oil Viscosity:

Outdoor Temperature		SAE
Fahrenheit	Centigrade	
Below 32_	0_C	10W or 15W40
32_ to 77_F	0_ to 25_C	20W or 15W40
Over 77_F	Over +25_C	30W or 15W40

Oil Change Intervals:

First 400 hours, thereafter as listed below.

CAUTION

The maximum oil change interval is 1 year (for either approved oil). The only approved synthetic lube oil is Mobil Delvac 1. The normal oil change intervals (listed below) should be reduced if the equipment is operated under extreme conditions such as in dirty environments.

ENGINE	API Class CD (Hours)	MOBIL DELVAC 1 (Hours)
TV	1500	3000
DI	2000	4000

1.3 COMPRESSOR DATA

Compressor Models	05G
No. Cylinders	6
No. Unloaders	2
Weight	62 kg (137 lbs)
Oil Charge	2.8 L (6.0 pints)

APPROVED COMPRESSOR OIL	
Refrigerant	05G
R-22	Zerol 150 (synthetic) P/N 07-00274
R-404A	Mobil Arctic EAL 68

1.4 REFRIGERATION SYSTEM DATA

a. Defrost Air Switch

Initiates Defrost:

1.40 (¦ .07) inch (35 ¦ 1.8 mm) WG

b. Defrost Timer (Microprocessor)

1-1/2, 3, 6, or 12 hours (Host Unit)
1-1/2 hours (Remote Evaporator)

c. Defrost Thermostats

Opens: 50 ¦ 5_F (10 ¦ 3_C)
Closes: 40 ¦ 5_F (4.4 ¦ 3_C)

d. Expansion Valve Superheat

Setting at 0_F (−17.8_C) box temperature:

8 to 10_F (4.4 to 5.6_C)

e. Fusible Plug Setting

208 to 220_F (97.8_ to 104.4_C)

f. Head Pressure Control Switch (HP-2)

Cutout: 300 ¦ 10 psig (21.1 ¦ 0.7 kg/cm@)
Cut-in: 200 ¦ 10 psig (14.1 ¦ 0.7 kg/cm@)

g. High Pressure Switch (HP-1)

Cutout: 465 ¦ 10 psig (32.7 ¦ 0.7 kg/cm@)
Cut-in: 350 ¦ 10 psig (24.6 ¦ 0.7 kg/cm@)

h. Refrigeration Charge

Refer to Table 1-1

i. Weights (Approximate)

Unit:

1710 lb. (776 kg)

Battery:

Dry: 35 lb (16 kg)
Wet: 50 lb (22.7 kg)

1.5 ELECTRICAL DATA

a. Generator (5kw)

Wattage	5000 Watts
Volts	240 v-ac
Phase	1
Speed	3600 rpm at 60 hz
Rotation	either direction

b. Remote Evaporator Fan Motors

Volts	230 v-ac
Horsepower	1/5 hp
Speed	2250 rpm
Amps	1.5

c. Remote Evaporator Heaters

1. Two Compartments

Number	4
Voltage	240 v-ac/1 ph/60hz
Wattage	1000 watts each

2. Three Compartments

Number	2
Voltage	240 v-ac/1 ph/60hz
Wattage	1000 watts each

d. Host Unit Evaporator Heaters

1. Two Compartments

Number	2
Voltage	240 v-ac/1 ph/60hz
Wattage	2000 watts each

2. Three Compartments

Number	2
Voltage	240 v-ac/1 ph/60hz
Wattage	1000 watts each

1.6 ENGINE SCREW THREADS

All threads used on the diesel engine are metric.

1.7 ENGINE AIR SYSTEM

The air cleaner is put on the engine to prolong its life and performance by preventing dirt and grit from getting into the engine causing excessive wear on all operating parts. However, it is the responsibility of the operator to give the air cleaner equipment regular and constant attention in accordance with the instructions. (Refer to section 4.3.3)

Clean air is supplied to the engine through the air cleaner (See Figure 1-4). The air is necessary for complete combustion and scavenging of the exhaust gases. As the engine piston goes through the intake stroke, the piston draws clean fresh air down into the cylinder for the compression and power strokes. As the engine goes through its exhaust stroke, the upward movement of the piston forces the hot exhaust gases out of the cylinders through the exhaust valves and the exhaust manifold. If the air filter is allowed to become dirty, the operation of the engine would be impaired.

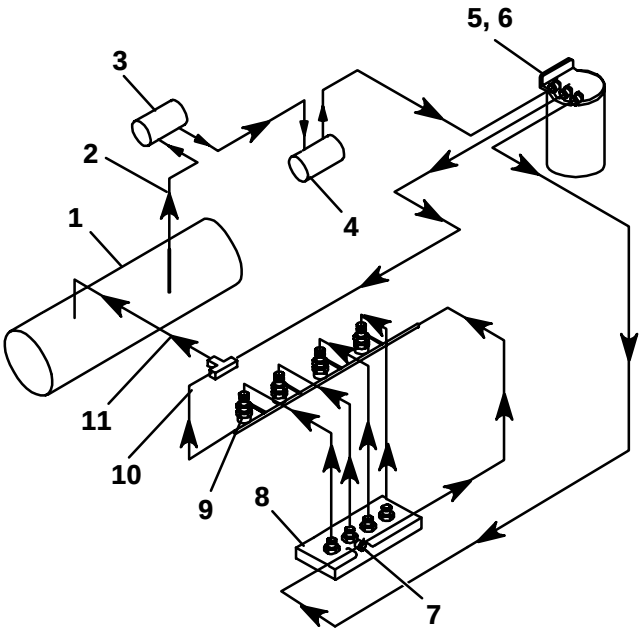
1.8 SAFETY DEVICES

System components are protected from damage caused by unsafe operating conditions by automatically shutting down the unit when such conditions occur. This is accomplished by the safety devices listed in Table 1-2.

The quench valve (R-22 Only) opens as required to maintain a 265 to 285_F (129 to 141_C) discharge temperature. Should this valve fail, the compressor discharge temperature sensor (CDT) will shut the unit down if center compressor head discharge temperature reaches 310_F (154_C) for 3 minutes or 350_F (177_C) . If ambient temperature sensor (ATS) is at 120_F (49_C) or higher, the CDT limits are increased to 340_F (171_C) for 3 minutes.

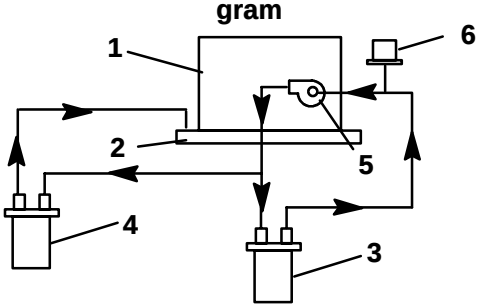
Table 1-2. Safety Devices		
Unsafe Conditions	**Safety Device**	**Device Setting**
1. Low engine lubricating oil pressure	Oil pressure safety switch (OP) (microprocessor reset)	Opens below 15 ¦ 3 psig (2.1 ¦ 1.2 kg/cm@)
2. High engine cooling water temperature	Water temperature sensor (microprocessor reset)	Engine off if 230 to 240_F for 5 minutes or immediately over 240_F (116_C)
3. Excessive current draw by glow plug circuit , control circuit or starter solenoid (SS)	Fuse (F1)	Opens at 80 amps
4. Excessive current draw by control circuit	Fuse (F3)	Opens at 25 amps
5. Excessive current draw by front or rear unloader	Fuse (F4)	Opens at 15 amps
6. Excessive current draw by SV3, auto restart or out-of-range lights	Fuse (F5)	Opens at 7 1/2 amps
7. Excessive current draw by microprocessor	Fuse (F9)	Opens at 5 amps
8. Excessive compressor discharge pressure	High pressure cutout switch (HP-1) automatic reset	Refer to section 1.4.g.
9. Excessive compressor discharge temperature	Compressor discharge temperature sensor (CDT) (microprocessor reset)	Refer to section 1.8
10. Defrost heater over temperature	High Temperature Klixon	Opens at 120 ¦ 5_F
11. Excessive current draw by 2 compartment controls	Fuse (F7)	Opens at 15 amps
12. Excessive current draw by 3 compartment controls	Fuse (F8)	Opens at 15 amps
13. Excessive current draw by electric heaters	Fuses (F10, F11)	Opens at 20 amps
14. Excessive current draw by 2 compartment fans	Fuses (F12, F13)	Opens at 3.2, 5 or 6.3 amps for 2, 3 or 4 fans
15. Excessive current draw by 3 compartment fans	Fuses (F14, F15)	Opens at 3.2 amps

1.9 LUBE OIL AND FUEL FLOW DIAGRAMS



1. Fuel Tank
2. Fuel Supply Line
3. Fuel Pump
4. Mechanical Lift Pump
5. Fuel Filter
6. Fuel Warmer (Optional)
7. Fuel Bleed Valve
8. Injection Pump
9. Injector Nozzles
10. Fuel Leak-off Line
11. Fuel Return Line

Figure 1-10. Fuel System Diagram



1. Engine Block
2. Oil Pan
3. Full Flow Oil Filter
4. Bypass Oil Filter (Optional)
5. Engine Oil Connection
6. Oil Pressure Switch

Figure 1-11. Lube Oil Flow Diagram

1.10 COMPRESSOR UNLOADERS

There are two modes of unloader operation, temperature control and suction pressure control.

1.10.1 Unloading in Temperature Mode

The compressor is equipped with unloaders (electronically controlled by the microprocessor) for capacity control.

The capacity controlled cylinders are easily identified by the solenoid which extends from the side of the cylinder head. When the solenoid is energized the cylinders unload. The unloaded cylinders operate with little or no pressure differential, consuming very little power. A de-energized solenoid reloads the cylinders.

NOTES

1. The unloader relay is locked in for a minimum of 2 minutes once it is energized due to suction pressure.
2. There is a delay of 10 seconds between de-energizing one unloader to de-energizing the other unloader.

a. Temperature Control Within 0.9_F (0.5_C) of Set Point

1. Cool light (CL) or heat light (HL) illuminated (depending on mode of operation).
2. If in cooling, unloader relays (UFR, or UFR & URR) may energize to unload compressor banks. Refer to Table 1-3

Table 1-3. Unloading in Temperature Mode

SETPOINT BELOW 10_F (--12_C)	CYLINDER	SETPOINT ABOVE 10_F (--12_C)	CYLINDER
Cool	6	Cool	6
	4		4
	2		2
		Heat	2
			6

b. Perishable Cooling Back-up Unloader Control

During perishable cooling the unloaders are energized when the temperature approaches setpoint. If a supply probe is present the unloaders are energized when the supply temperature decreases 5.4_F (3_C) below setpoint. It will stay unloaded until the supply temperature rises above setpoint. If a supply probe is not present the unloaders are energized when the return temperature decreases more than 9_F (5_C) above setpoint. It will stay unloaded until the return temperature rises more than 14.4_F (8_C) above setpoint. With software revision 2.10 or higher the return probe logic is disabled for ambient temperature higher than 90_F (32.2_C).

c. Perishable Heating Unloader Control

During perishable heating the unloaders are energized when the control temperature increases to 2.3_F (1.3_C) below setpoint. The unloaders will stay energized until the control temperature decreases to 2.7_F (1.5_C) below setpoint.

Note: These switch points may vary slightly depending on the amount of overshoot around setpoint.

1.10.2 Suction Pressure Operation

The microprocessor will monitor suction pressure of the refrigeration system and control the unloaders to maintain a maximum operating pressure. A suction pressure transducer is used to signal the microprocessor when to load or unload the compressor.

When the compressor is fully loaded it is operating on 6 cylinders. When the front unloader UL1 is unloaded (energized), the unit operates on 4 cylinders. When UL1 and the rear unloader UL2 are unloaded (energized), the unit operates on 2 cylinders. The front unloader, UL1, always unloades before the rear unloader, UL2.

During the diesel heating and defrosting cycles, the rear unloader is locked out (loaded), forcing the compressor to always operate with at least four cylinders loaded.

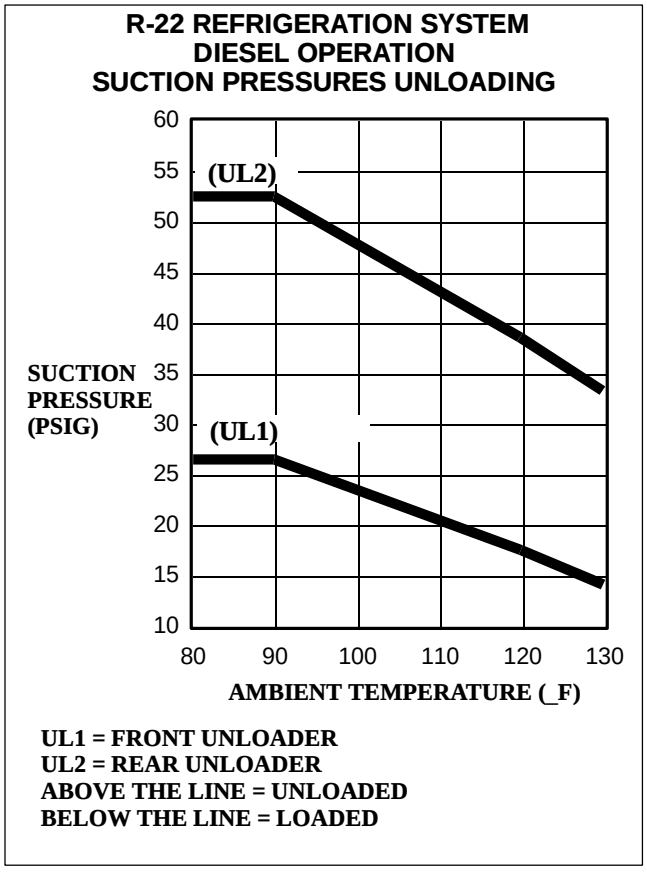
a. R-22 Refrigeration System

At ambient temperatures of 90_F (32.2_C) or below

When the suction pressure is greater than 53 psig, both unloaders are unloaded. As the suction pressure drops below 52 psig, the UL2 unloader is loaded. If the suction pressure drops below 26 psig, the UL1 unloader is loaded.

At ambient temperatures of 90_F (32.2_C) or higher

At ambient temperatures of 90_F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)



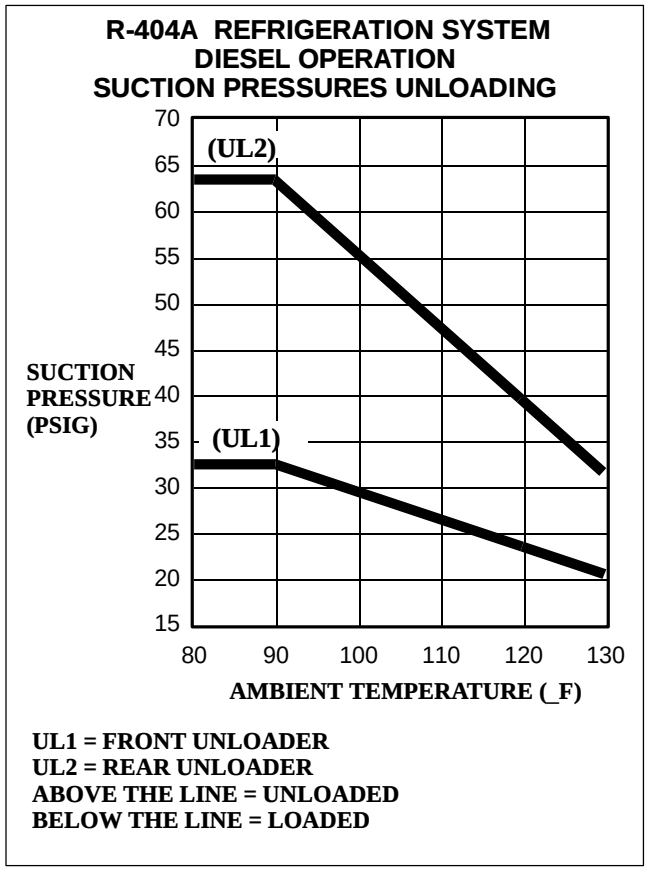
b. R-404A Refrigeration System

At ambient temperatures of 90_F (32.2_C) or below

When the suction pressure is greater than 64 psig, both unloaders are unloaded. As the suction pressure drops below 64 psig, unloader UL2 is loaded. If the suction pressure drops below 33 psig, unloader UL1 is loaded.

At ambient temperatures of 90_F (32.2_C) or higher

At ambient temperatures of 90_F or higher the unloading suction pressure settings relative to ambient temperatures are a straight line.(Refer to chart below)



1.10.3 Unloading During 4-kw Heating R404A Only

The HCR relays (see Figure 1-8) energize the rear unloader during all 4-kw heating situations which do not also require hot gas heating. 4-kw heating occurs when one compartment calls for heating in a two compartment system and when two compartments call for heating in a three compartment system. If all compartments call for heating, then the host will heat using hot gas and the rear unloader will remain de-energized. All of these possible different operating modes are shown in Table 2-2 and Table 2-3.

1.10.4 Hot Gas Bypass Unloader

a. Major Working Parts

1. Solenoid and valve system
2. Spring loaded piston type bypass control valve
3. Spring loaded discharge check valve

b. Unloaded Operation

Pressure from the discharge manifold (Figure 1-12, item 15) passes through the strainer (9) and bleed orifice (8) to the back of the piston bypass valve (7). Unless bled away, this pressure would tend to close the piston (6) against the piston spring (5) pressure.

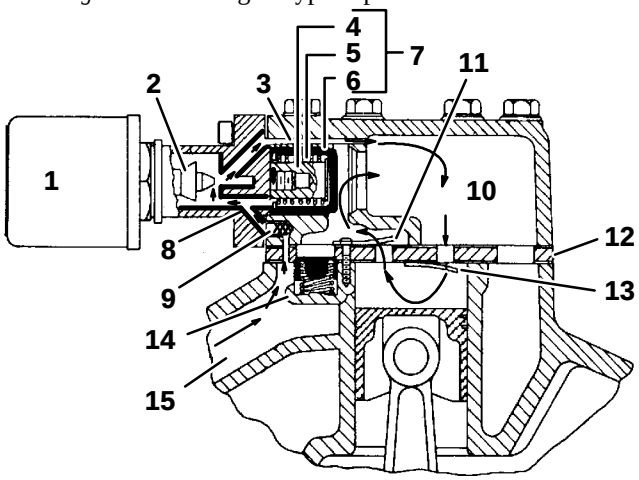
With the solenoid valve (1) *energized* the solenoid valve stem (2) will *open* the gas bypass port (3).

Refrigerant pressure will be bled to the suction manifold (10) through the opened gas bypass port . A reduction in pressure on the piston bypass valve will take place because the rate of bleed through the gas bypass port is greater than the rate of bleed through the *bleed orifice* (8)**.**

When the pressure behind the piston has been reduced sufficiently, the valve spring will force the piston bypass valve *back*, *opening* the gas bypass from the discharge manifold to the suction manifold.

Discharge pressure in the discharge manifold will close the discharge piston check valve assembly (14) isolating the compressor discharge manifold from the individual cylinder bank manifold.

The *unloaded* cylinder bank will continue to operate *fully unloaded* until the solenoid valve control device is *de-energized* and the gas bypass port is closed.



1. Solenoid Valve
2. Valve Stem
3. Gas Bypass Port
4. Spring Guide
5. Spring
6. Piston
7. Piston Bypass Valve
8. Bleed Orifice
9. Strainer
10. Suction Manifold
11. Cylinder Discharge Valve
12. Valve Plate
13. Cylinder Suction Valve
14. Discharge Piston Check Valve Assembly
15. Discharge Manifold

Figure 1-12. Compressor Cylinder Head Unloaded Hot Gas Bypass

c. Loaded Operation

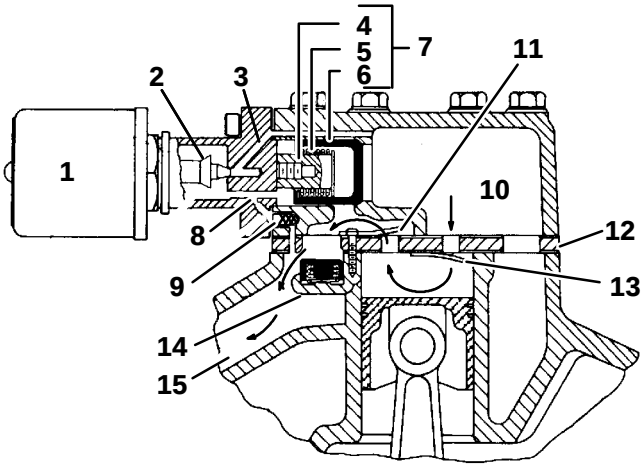
Discharge pressure bleeds from the discharge manifold (Figure 1-13, item 15) through the strainer (9) and (8) bleed orifice to the solenoid valve stem (2) chamber and the back of the piston bypass valve (7).

With the solenoid valve (1) *de-energized* the solenoid valve stem will *close* the gas bypass port (3).

Refrigerant pressure will overcome the bypass valve spring (5) tension and force the piston (6) *forward closing* the gas bypass from the discharge manifold to the suction manifold (10).

Cylinder discharge pressure will force open the discharge piston check valve assembly (14). Refrigerant gas will pass into the compressor discharge manifold.

The loaded cylinder bank will continue to operate fully loaded until the solenoid valve control device is energized and the gas bypass port is opened.



1. Solenoid Valve
2. Valve Stem
3. Gas Bypass Port
4. Spring Guide
5. Spring
6. Piston
7. Piston Bypass Valve
8. Bleed Orifice
9. Strainer
10. Suction Manifold
11. Cylinder Discharge Valve
12. Valve Plate
13. Cylinder Suction Valve
14. Discharge Piston Check Valve Assembly
15. Discharge Manifold

Figure 1-13. Compressor Cylinder Head Loaded Hot Gas Bypass

1.11 MICROPROCESSOR CONTROLLER

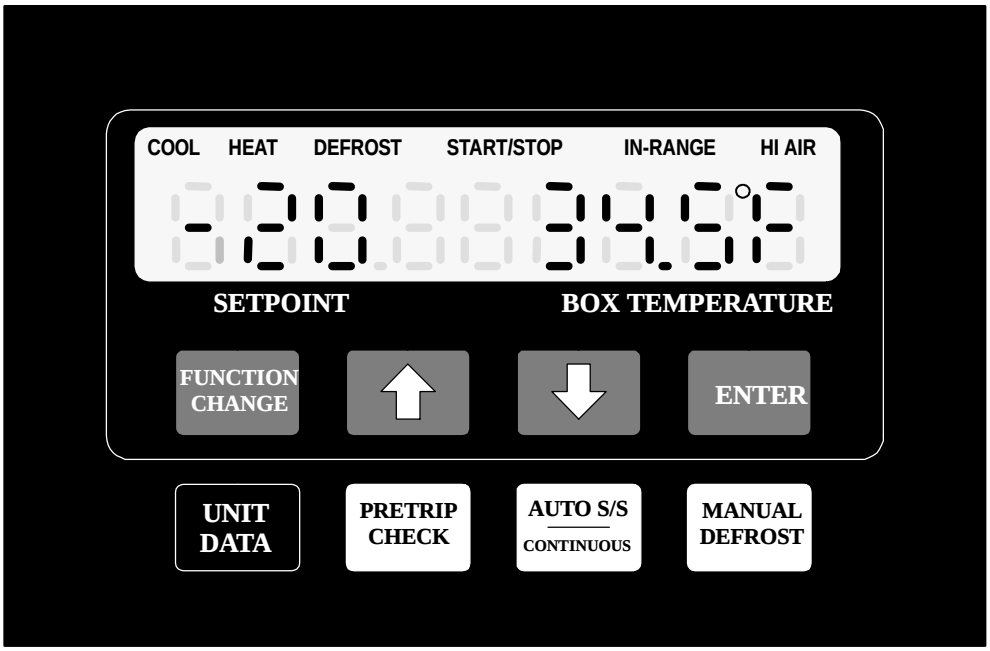


Figure 1-14. Microprocessor Control Panel

1.11.1 INTRODUCTION

The microprocessor controller is housed in the control panel on the lower roadside corner of the unit. This controller consists of 2 control boards and a relay module:

1. The Processor Board includes the microprocessor, program memory, and necessary input/output circuitry to interface with the unit.
2. The Display Board is mounted in the same control box as the processor board. The display board includes the LCD display, keypad and keypad interface.
3. The Relay Module contains replaceable relays, diode blocks and fuses along with the wiring harness.

The microprocessor is totally self-contained and does not contain any serviceable components.

CAUTION

Under no circumstances should anyone attempt to repair the Logic or Display Boards! (see section 4.27) Should a problem develop with these component, contact your nearest Carrier Transicold dealer for replacement.

The Carrier Transicold microprocessor controller incorporates the following features:

a. Control supply or return air temperature to tight limits by providing refrigeration control, heat and defrost to ensure conditioned air delivery to the load.

b. Dual independent readouts of set point and supply or return air temperatures.

c. Digital readout and ability to select data. Refer to Table 1-4 for Function Code and Table 1-5 for Unit Data.

d. For alarm digital display identification refer to Table 1-6.

e. A pre-trip checkout of refrigeration unit operation. Refer to section 1.11.8

f. A self-test check on program memory and data memory. The self-test is executed each time the system is switched from “Stop” to “Start.” Errors, if any, shall be indicated on the display as a ERR.X, where X is a number corresponding to the number of the test. The unit shall display this error for 5 seconds and then reset the micro.

ERROR	CAUSE
ERR.1 ERR.2 ERR.3	Processor failure Check chip installation or Replace microprocessor.
ERR.4 or Display	Display board to logic board communication failure. This can be caused by a defective ribbon cable or ribbon cable not plugged in properly.

g. A communication link to transmit unit operational data to a remote computer. Refer to section 1.11.12

1.11.2 KEYPAD

The keypad has 8 keys which will allow the operator to initiate various functions, display operating data and change operating parameters.

Arrow Keys

The keypad has UP and DOWN Arrow keys which are used to modify (increment or decrement) the setpoint selection or modify the displayed data.

Enter Key

The ENTER key is used to accept a change in unit parameters or a change in setpoint.

Manual Defrost Key

The MANUAL DEFROST key is used to initiate a defrost cycle, given that the proper conditions are met (Refer section 1.11.10).

Pretrip Check Key

The PRETRIP CHECK key is used to initiate a pretrip cycle, given that the proper conditions are met (Refer to section 1.11.8).

Auto Start/Stop Continuous Key

NOTES

1. With software revisions 3.08 or 3.12 when configuration CNF11 is "ON" and setpoint is 32 to 42_ F (0 to 5.5_C), the unit is locked into continuous run. Start/Stop Continuous key is disabled in this setpoint range.
2. With software revision 3.15 or higher when configurations CNF3 & CNF11 are "ON" and setpoint is 32 to 42_ F (0 to 5.5_C), the unit is locked into continuous run. Start/Stop Continuous key is disabled in this setpoint range.

The START/STOP CONTINUOUS key is used to change the operating mode from "auto start/continuous run" to "auto start/stop." Each push of the key will alternate the operating modes. The operating status will be stored in memory and will be retained through power outages. The digital display will indicate when stop/start is enabled (Also See Section 1.11.11).

To start the unit in manual start mode, the START/STOP CONTINUOUS selection must be in continuous run mode.

Function Change Key

The FUNCTION CHANGE key is used to display the operating parameters. Each time this key is pressed the display will advance to the next parameter. This key, in conjunction with the UP/DOWN Arrow and ENTER keys, will allow the user to change the parameters (See Section 1.11.5).

Unit Data Key

The UNIT DATA key is used to display the unit operating data. This key, in conjunction with the UP/DOWN Arrow keys, will allow the user to display the unit's operating data values (i.e, coolant temperature, battery voltage, etc.) (See Section 1.11.6).

1.11.3 SETPOINT

Setpoints of −22_F to +86_F (−30_C to +30_C) may be entered via keypad. The controller always retains the last entered setpoint in memory. If no setpoint is in memory (i.e., on initial startup), the controller will lock out the run relay and flash "SP" on the left hand display until a valid setpoint is entered.

The setpoint may be changed up or down in whole numbers until the desired setpoint is displayed. The display will flash to indicate that the setpoint reading being displayed is a non-entered value. Each time the UP/DOWN Arrow key is pressed, the 5 second display timer will be reset.

Depressing the ENTER key will cause the new displayed setpoint value to become active. If the display is flashing and the new value is not entered, after 5 seconds of no keyboard activity, the display will revert back to the active setpoint.

1.11.4 DIGITAL DISPLAY

The digital display has 9 digits. The default display is setpoint on the left and controlled air temperature on the right. The readout is keypad selectable for Degrees C or Degrees F.

Also digital displays are provided to indicate the following modes: COOL, HEAT, DEFROST, IN-RANGE, HI AIR, START/STOP.

On each power-up, the unit will display a Display Test for 5 seconds then display the default reading.

1.11.5 FUNCTIONAL PARAMETERS

NOTE

If configuration CNF11 is "ON" functional parameters are lockout. The ability to change functional parameters from keypad are disabled.

The functional parameters will control selected operating features of the unit. These parameters can be displayed by pressing the FUNCTION CHANGE key. All functional parameters are retained in memory. The following sections describe the list of functions which can be modified via the keypad. A description of the function will be displayed on the left side with the corresponding data on the right side. The function parameter list can be scrolled through by pressing the FUNCTION CHANGE key or by using the UP/DOWN Arrow keys. With each FUNCTION CHANGE key push, the list will be advanced one. If the function key is pressed and held for one second, the list will be advanced one item at a time. This list will be circular, meaning once the end of the list is reached the list will go to the first entry. While the functional parameter is displayed, the data can be changed by pressing ENTER then pressing either the UP or DOWN Arrow keys. If the value is changed, the displayed data will then flash to indicate that the value has not been entered. If the new value is not entered in 5 seconds, the display will revert back to the last entered value. If the ENTER key is pressed, the display will stop flashing to indicate that the value has been entered. The new value will continue to be displayed for 5 seconds before reverting back to the default display. Each time a key is pressed, the 5 second delay will be reset. To select a

different functional parameter the FUNCTION CHANGE key must be pressed first.

Code Vs English Messages

The description messages of the functional parameters, unit status and alarms can be displayed in English or Codes through this function selection. The two choices will be displayed as, ENGLISH or CODES. With this parameter set to CODES, all display descriptions will be set to their code display. This parameter will not change due to this selection. Refer to each section for the alternate display description.

Manual Glow Override

The auto start glow time can be manually overridden through this function. The messages is displayed as NORM GLOW or ADD GLOW. If the ADD GLOW selection is entered, the control will add 30 seconds of glow to the glow times listed in section 1.11.11. This feature must be selected before the 3 start attempts have been completed. At higher ambients, this override will only affect the second or third start attempt. The add glow time is deselected when the engine starts or fails to start. This parameter will not change due to the Code vs English selection.

Alarm Reset

Alarms can be reset through this function. The messages are displayed as ALARM RST or ALARM CLR. If the ALARM RST is displayed then there is at least one alarm present. Pressing the ENTER key will clear all the alarms present. If the ALARM CLR is displayed then there are no alarms present. See section 1.11.7. This parameter will not change due to the code vs English selection.

Table 1-4. Function Codes

CODE	ENGLISH	DATA
FN0	DEFR	Defrost Interval
FN1 ON	HIGH AIR	NOT APPLICABLE
FN1 OFF	NORM AIR	NOT APPLICABLE
FN2	OFF T	Off-time
FN3	ON T	On-time
FN4 A	REM PROBE	Controlling Probe – Return Air
FN4 B	SUP PROBE	Controlling Probe – Supply Air
FN5	Degrees F or C	Temperature Unit _C or _F
FN6 ON	TIME STRT	Maximum Off-time 30 Min.
FN6 OFF	TEMP STRT	Temperature Based Restarting
FN7	MOP STD	Future Expansion
FN8	2SET	Compartment 2 Setpoint
FN9	3SET	Compartment 3 Setpoint
FN10 ON	AUTO OP	Auto Start Operation
FN10 OFF	MAN OP	Manual Start Operation
FN11	T RANGE	Out-of-Range Tolerance
Code vs English = Code or English display format		
Manual Glow Override = Normal or Add 30sec		
Alarm Reset = Alarm Reset or No Alarms		

Defrost Interval (Main Unit)

The defrost interval is displayed with the description DEFR or FN0. The data for the interval will be displayed with one decimal place and then the capital letter H for hours (i.e., DEFR 12.0H). The defrost intervals are 1.5, 3, 6 or 12 hours.

Airflow -- Not Applicable

The data is not applicable for this application.

Off-Time

The off-time selection for the auto start mode is displayed with the description OFF T or FN2. The off-times are 10, 20, 30, 45 or 90 minutes. The data for the off-time will be displayed with two digits and then the capital letter M for minutes (i.e. OFF T 20M).

On-Time

The on-time selection for the auto start mode is displayed with the description ON T or FN3. With software revision less than 3.11 the on-times are 4 or 7 minutes. With software revision 3.11 or higher the on-time is 4 minutes. The data for the on-time will be displayed with two digits and then the capital letter M for minutes (i.e. ON T 4M).

Controlling Probe

The number of controlling probes is displayed with the following abbreviations: REM PROBE for a single probe (return air) control; SUP PROBE for a dual probe control (return and supply air). The code display is FN4. The 1-probe setting is "A" and the 2-probe setting is "B."

Standard Units Select

The standard unit select will control how all parameters are displayed. The two choices are DEGREES F and DEGREES C. This parameter also will control units that data is displayed in psig or bars (i.e, Degrees F or Degrees C). The code display is FN5. The selections are "F" or "C."

Maximum Off Time

The description for the maximum off time is TEMP STRT OR TIME STRT. The code display is FN6 and the selections are "ON" or "OFF." "ON" corresponds to TIME STRT. With the unit in time start, the control will force the engine to restart 30 minutes after shutoff.

MOP STD -- Future Expansion

This function is not used at this time. The display is FN7.

Compartment 2 Setpoint

Setpoints of –22_F (–30_C) to +86_F (+30_C) may be entered through this function for the second compartment. The setpoint function will be displayed with the abbreviated description 2SET. The code display is FN8. The setpoint may be changed up or down in whole numbers until the desired setpoint is displayed. The display will flash to indicate that the setpoint reading being displayed is a non-entered value. Each time the UP key or the DOWN key is pressed, the 5 second display timer will be reset. Depressing the ENTER key will cause the new displayed setpoint value to become active. If the display is flashing and the new value is not entered, after 5 seconds of no keyboard activity, the display will revert back to the active setpoint. The update rate is once every 0.5 seconds if the UP or DOWN keys are held down.

Compartment 3 Setpoint

Setpoints of −22_F (−30_C) to +86_F (+30_C) may be entered through this function for the third compartment. The setpoint function will be displayed with the abbreviated description 3SET. The code display is FN9. The setpoint may be changed the same as the 2nd compartment.

Auto/Manual Start Operation

The selection for starting the unit are displayed AUTO OP (code FN10 ON) for auto start operation or MAN OP (code FN10 OFF) for manual start operation.

To start the unit in manual start mode, the START/STOP CONTINUOUS selection must be in "continuous run" mode.

Out-of-Range Tolerance

The out-of-range temperature tolerance selection is displayed with the description T RANGE or code FN11. The selection are "A, B or C" 2, 3, or 4_C (3.6, 5.4, or 7.2_F) respectively.

When the out-of-range temperature is configured ON, the controller indicates out-of-range when the temperature has been within the tolerance band at least once, and then goes outside the tolerance band for 45 minutes. Also the unit will shut down.

When the out-of-range temperature is configured OFF, the controller indicates out-of-range when the temperature has been within the tolerance band at least once, and then goes outside the tolerance band for 15 minutes. Also the unit will continue to operate.

For set points below +10_F (−12.2_C) *frozen range* the unit is only considered out-of-range for temperatures above set point.

1.11.6 UNIT DATA

The UNIT DATA key can be used to display the unit operating data values. The data values will be displayed for 5 seconds and then the display will revert back to the normal display if no further action is taken. The following sections describe the list of data which can be displayed via the keypad. The description of the data will be displayed on the left side with the actual data on the right side. The unit data list can be scrolled through by pressing the UNIT DATA key. With each successive key push, the list will be advanced one. If the UNIT DATA, UP or DOWN Arrow key is held for one second, the list will change at a rate of one item every 0.5 seconds. This list will be circular, meaning once the end of the list is reached the list will go to the first entry. Each time the UNIT DATA key or the UP/DOWN Arrow key is pressed, the display time will be reset to 5 seconds. If the ENTER key is pressed, the display time will be set to 30 seconds. The position in the unit data list will remain at the last selected value except if power is removed. If the display were to time out and revert to the default display, the operator would only have to press the UNIT DATA key to display the same data again.

Table 1-5. Unit Data Codes

CODE	ENGLISH	DATA
CD1	SUCT	Suction Pressure
CD2	ENG	Engine Hours
CD3	WT	Engine Temperature
CD4	RAS	Return Air Temperature
*CD5	SAS	Supply Air Temperature
*CD6	REM	Remote Air Temperature
CD7	ATS	Ambient Temperature
CD8	EVP	Future Expansion
CD9	CDT	Discharge Temperature
CD10	BATT	Battery Voltage
CD11	SBY	Standby Hours
CD12	MOD V	Future Expansion
CD13	REV	Software Revision
CD14	SERL	Serial Number Low
CD15	SERU	Serial Number Upper
CD16	2RA	Compartment 2 Air Temperature
CD17	3RA	Compartment 3 Air Temperature
CD18	MHR1	Maintenance Hour Meter 1
CD19	MHR2	Maintenance Hour Meter 2
CD20	SON	Switch On Hour Meter

* Codes 5 & 6 are variable. SAS is displayed when the SUP Probe Function is selected. REM is displayed when the REM Probe Function is selected.

Suction Pressure

The suction pressure is displayed with the description SUCT or CD1. The data is displayed with the proper unit designator P (psig) or B (Bars) (i.e. SUCT 25P). The display is in inches of mercury for readings below 0 psig. The display range is −20 HG to 420 psig (−0.7 Bars to 29.4 Bars).

Engine Hours

The number of diesel engine hours are displayed with the description ENG or CD2. The data is displayed with units designator H (i.e, ENG 5040H OR CD2 5040H). The display range is 0 to 99999.

Engine Temperature

The coolant temperature is displayed with the description WT or CD3. The data is displayed with the proper unit designator (Degree C or Degree F (i.e, WT 185F or CD3 185F). The display range is 10_F to 266_F (−12_C to 130_C).

Return Air Temperature

The return air temperature is displayed with the description RAS or CD4. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. RAS 85.0F). The display range is −36_F to 158_F (−38_C to 70_C).

Supply Air Temperature

The supply air temperature is displayed with the description SAS or CD5. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. SAS 85.0F). The display range is −36_F to 158_F (−38_C to 70_C). This unit data will be displayed only if the SUP PROBE is selected in the controlling probe functional parameter.

Remote Air Temperature

The remote air temperature is displayed with the description REM or CD6. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. REM 85.0F). The display range is −36_F to 158_F (−38_C to 70_C). This unit data will be displayed only if the REM PROBE is selected in the controlling probe functional parameter.

Ambient Temperature

The ambient temperature is displayed with the description ATS or CD7. The data is displayed with one decimal place and the proper unit designator, Degree C or Degree F, (i.e. ATS 85.0F) . The display range is −36_F to 158_F (−38_C to 70_C). If there is no sensor, then the display will read −−− for the data.

Evp -- Future Expansion

This unit data is not used at this time. The Code display is CD8.

Compressor Discharge Temperature

The compressor discharge temperature is displayed with the description CDT or CD9. The data is displayed with the proper unit designator, Degree C or Degree F, (i.e. CDT 85F) . The display range is −40_F to 392_F (−40_C to 200_C). If there is no sensor, then the display will read −−− for the data.

Battery Voltage

The battery voltage is displayed with the description BATT or CD10. The data is displayed with one decimal place and then the capital letter V for volts (i.e, BATT 12.2V or CD10 12.2V). The voltage reading is displayed with a "+" plus sign if the battery status is high enough to allow unit shut down in "Auto Start/Stop".

Standby Hours

The number of electric motor hours are displayed with the description SBY or CD11. The data is displayed in hours and units designator H (i.e, SBY 5040H or CD11 5040H). The display range is 0 to 99999.

Mod V -- Future Expansion

This unit data is not used at this time. The Code display is CD12.

Software Revision

The Eprom software revision number is displayed with the description REV or CD13 on the left and Eprom software revision number on the right side. Pressing the ENTER key for 3 seconds will display REV U2 on the left and the board mounted software revision number on the right side.

Serial Number Low

The low serial number of the unit is displayed with the description SERL or CD14. The data is the lower 3 digits of the serial number burned in to the Eprom. (i.e, SERL 504 or CD14 504).

Serial Number Upper

The upper serial number of the unit is displayed with the description SERU or CD15. The data is the upper 3 digits of the serial number burned in to the Eprom. (i.e, SERH 001 or CD15 001).

Compartment 2 Air Temperature

The air temperature for the second compartment will be displayed with the abbreviated description 2RA on the left-hand side. The code display is CD16. The data will be displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. 2RA85.0F).

Compartment 3 Air Temperature

The air temperature for the second compartment will be displayed with the abbreviated description 3RA on the left-hand side. The code display is CD17. The data will be displayed with one decimal place and the proper unit designator, Degree C or Degree F (i.e. 3RA85.0F).

Maintenance Hour Meter 1

The maintenance hour meter 1 setting is displayed with the description MHR1 or CD18. The maintenance hour meter is compared to one of the hour meters (diesel, standby, or switch on) determined by its mode. If the hour meter is greater than the maintenance hour meter an alarm will be generated.

Maintenance Hour Meter 2

The maintenance hour meter 2 setting is displayed with the description MHR2 on the left side or CD19. The maintenance hour meter is compared to one of the hour meters (diesel, standby, or switch on) determined by its mode. If the hour meter is greater than the maintenance hour meter an alarm will be generated.

Switch On Hour Meter

The number of switch on hours is displayed with the description SON or CD20 (i.e. SON 2347H or CD20 2347H). The display range is 0 to 99999.

1.11.7 ALARM DISPLAY

The fault light (FL) is turned on only for alarms that specify it. The default display will be overridden if a alarm is generated. When an alarm is generated, the display will alternate the default display (setpoint/air temperature) and the active alarm(s). Each item will be displayed for 3 to 10 seconds, and will continue to scroll through the list. See section 1.11.5 for the procedure on resetting alarms.

Table 1-6. Alarm Display

CODE	ENGLISH	ALARM DESCRIPTION
AL0	ENG OIL	✔Low Oil Pressure
AL1	ENG HOT	✔High Coolant Temperature
AL2	HI PRESS	✔High Pressure
AL3	STARTFAIL	✔Auto Start Failure
AL4	LOW BATT	✔Low Battery Voltage
AL5	HI BATT	✔High Battery Voltage
AL6	DEFRFAIL	Defrost Override
AL7	ALT AUX	✔Alternator Auxiliary
AL8	STARTER	✔Starter Motor
AL9	RA SENSOR	✔Return Air Sensor
AL10	SA SENSOR	Supply Air Sensor
AL11	WT SENSOR	Coolant Temperature Sensor
AL12	HIGH CDT	✔High Discharge Temperature
AL13	CD SENSOR	Discharge Temperature Sensor
AL14	SBY MOTOR	✔Motor Overload
AL15	FUSE BAD	✔Fuse
AL17	DISPLAY	Display
AL18	SERVICE 1	Maintenance Hour Meter 1
AL19	SERVICE 2	Maintenance Hour Meter 2
AL20	OUT RANGE	✔Main Compartment Out-of-range
AL21	2RA OUT	✔Remote Compartment 2 Out-of-range
AL22	3RA OUT	✔Remote Compartment 3 Out-of-range
✔ = FAULT LIGHT ON		

Low Oil Pressure Alarm

The low oil pressure alarm is displayed with the description ENG OIL or AL0. This alarm is generated if the control senses low oil pressure under the proper conditions. The fault light (FL) is turned on. Engine will shut down.

High Coolant Temperature Alarm

The high coolant temperature alarm is displayed with the description ENG HOT or AL1. This alarm is generated if the control senses a high coolant temperature 230 to 240_F (110 to 116_C) for 5 minutes or immediately if over 240_F (116_C). The fault light (FL) is turned on and engine will shut down.

High Pressure Alarm

The high pressure alarm is displayed with the description HI PRESS or AL2. This alarm is generated if the high pressure switch opens. The fault light (FL) is turned on and engine will shut down.

Start Failure Alarm

The start failure alarm is displayed with the description STARTFAIL or AL3. This alarm is generated if the engine fails to start. The fault light (FL) is turned on.

If function MAN OP (manual start mode) is selected the start failure alarm will be generated if the engine fails to start in 5 minutes.

Low Battery Voltage Alarm

The low battery voltage alarm is displayed with the description LOW BATT or AL4. This alarm is generated if the battery voltage falls below 10 vdc. The fault light (FL) is turned on and engine will shut down.

High Battery Voltage Alarm

The high battery voltage alarm is displayed with the description HI BATT or AL5. This alarm is generated if the battery voltage is above 17 vdc. The fault light (FL) is turned on and engine will shut down.

Defrost Override Alarm

The defrost override alarm is displayed with the description DEFR FAIL or AL6. This alarm is generated if the unit is in a defrost override mode (See Section 1.11.10).

Alternator Auxiliary Alarm

The alternator auxiliary alarm is displayed with the description ALT AUX or AL7. This alarm is generated if the alternator auxiliary signal is not present with the engine running. (See Section 1.11.11) The fault light (FL) is turned on.

Starter Motor Alarm

The starter motor alarm is displayed with the description STARTER or AL8. This alarm is generated if the starter motor input signal is not present with starter solenoid energized. The fault light (FL) is turned on.

Return Air Sensor Alarm

The return air sensor alarm is displayed with the description RA SENSOR or AL9. This alarm is generated if the return air sensor is open or shorted. The fault light (FL) is turned on if the unit shuts down because there is no controlling probe.

Supply Air Sensor Alarm

The supply air sensor alarm is displayed with the description SA SENSOR or AL10. This alarm is generated if the supply air sensor is open or shorted. This alarm will be disabled if the REM PROBE is selected in the controlling probe functional parameter.

Coolant Temperature Sensor Alarm

The coolant temperature sensor alarm is displayed with the description WT SENSOR or AL11. This alarm is generated if the coolant temperature sensor is open or shorted.

Compressor Discharge Temperature Alarm

The compressor discharge temperature alarm is displayed with the description HIGH CDT or AL12. This alarm is generated and unit shuts down if the temperature is sensed above 310_ F for 3 minutes. If the discharge temperature exceeds 350_ F, the 3 minute timer will be overridden and the unit shut down immediately. If ambient temperature sensor (ATS) is at 120_F (49_C) or higher, the CDT limits are increased to 340_F (171_C) for 3 minutes. The fault light (FL) is turned on.

Compressor Discharge Temperature Sensor Alarm

The compressor discharge temperature sensor alarm is displayed with the description CD SENSOR or AL13. This alarm is generated if the sensor is open or shorted.

Standby Motor Overload Alarm

The standby motor overload alarm is displayed with the description SBY MOTOR or AL14. This alarm is generated when the MOL input is sensed open with the Run Relay energized in electric mode (Diesel/Electric Relay energized).

Fuse Alarm

The fuse alarm is displayed with the description FUSE BAD or AL15. This alarm is generated when the FUSE input is sensed low. The fault light (FL) is turned on.

Display Alarm

When no communications exist between the main board and the display board for 8 seconds, the display alarm description is DISPLAY or AL17

Maintenance Hour Meter 1 Alarm

The maintenance hour meter alarm 1 is displayed with the description SERVICE 1 or AL18. This alarm is generated when the designated hour meter is greater than maintenance hour meter 1.

Maintenance Hour Meter 2 Alarm

The maintenance hour meter alarm 2 is displayed with the description SERVICE 2 or AL19. This alarm is generated when the designated hour meter is greater than maintenance hour meter 2.

Out-of-Range Alarm

The out-of-range alarm is displayed with the description OUT RANGE or AL20. This alarm is generated when the main compartment is out-of-range refer to section 1.11.5. The fault light (FL) is turned on.

Remote Compartment 2 Out-of-range Alarm

The Code display is AL21. This alarm is generated when the remote compartment 2 is out-of-range refer to section 1.11.5. The fault light (FL) is turned on.

Remote Compartment 3 Out-of-range Alarm

The Code display is AL22. This alarm is generated when the remote compartment 3 is out-of-range refer to section 1.11.5. The fault light (FL) is turned on.

1.11.8 PRE-TRIP

The PRETRIP key is for checking unit operation and evaluating operation of all modes and indicating a failure when detected. The following details the sequence :

a. Unit operating and box temperature is below 40_F (4.4_C).

b. Operator presses the PRETRIP key. If the defrost thermostat (DTT) is closed, the controller will display "PPPP." If DTT is open, no response – end of test.

c. Controller displays "PPPP" Pre-trip mode is started.

d. After 30 seconds in cool, unit cycles to loaded cool.

e. After 30 seconds, unit cycles to unloaded cool.

f. After 30 seconds, unit cycles to unloaded heat.

g. After 30 seconds, unit cycles to loaded heat.

h. After 30 seconds, unit cycles to heat and displays coolant temperature.

i. After 30 seconds, unit cycles to cool and displays defrost interval selected for 30 seconds, then unit cycles to defrost if DTT is closed.

j. After standard defrost cycle, Pre-trip is terminated and unit returns to normal operation.

1.11.9 HEAT/COOL MODE

There are two control ranges, Frozen and Perishable. The Frozen range is active with set points at or *below +10*_F *(–12_C*) and the Perishable range is active at set points *above +10*_F *(–12_C*).

The system is configured for cooling mode for engine start and during the oil pressure delay.

Hot gas heating is applied by energizing the HR1 and HR2 relays which will energize the hot gas solenoids. These relays will also control the remote heat and cool lights.

Hot gas heating is locked out of operation at setpoint temperatures less than *+10*_F *(–12_C*) except during defrost. Electric heat is available if remotes are not in full heat.

Default Mode

When in frozen range (setpoint at or *below +10*_F), unit shall default to unloaded (2 cylinder) if a loss of control (bad sensor) is detected. When in perishable range (setpoint *above +10*_F), the unit shall shut down. The proper alarm indication shall be displayed when this mode is active.

1.11.10 DEFROST CYCLE

Defrost is an independent cycle overriding cooling and heating functions to de-ice the evaporator as required. The controller displays "DF" during defrost mode on the right hand temperature display. The left hand display will continue to display the setpoint.

a. Defrost Timer Initiation

A defrost timer initiation is a keyboard selection (Refer to Section 1.11.5). The defrost timer is reset to zero whenever a defrost cycle is initiated. The controller holds in memory the last entered defrost interval.

b. Defrost Air Switch Initiation

An external defrost signal (DA) may be supplied as a set of normally open switch contacts closing to initiate the defrost cycle.

c. Manual Defrost Initiation

The defrost cycle may be initiated by pushing the MANUAL DEFROST key.

d. Defrost Function

The defrost mode is initiated upon expiration of the defrost timing interval with the presence of a signal from the defrost termination thermostat (DTT). It may also be initiated by the presence of a momentary manual defrost signal. Defrost may also be initiated by an external defrost signal from a device such as an air switch. The defrost mode terminates when the defrost termination thermostat (DTT) opens indicating the defrost cycle is complete. The defrost timer runs only when the DTT is closed. The defrost interval timer resets to zero when defrost is initiated by any means. The timer does not accumulate time during defrost mode or auto-start off cycles.

A defrost output is energized during defrost mode to de-energize the clutch to prevent hot air circulation to the load.

In addition, the heating outputs (HR1 & HR2) are enabled to apply heat for hot gas heating.

The compressor operates at maximum capacity on diesel and diesel/electric units during defrost. The suction pressure signal can force the unloaders to be unloaded.

e. Fail safe Defrost Termination

Should the defrost cycle not complete within 45 minutes or if the external defrost signal does not clear at defrost termination, the defrost cycle is terminated. The internal timer is reset for 1.5 hours and the external defrost signal is ignored for defrost initiation. The manual defrost switch will override this mode and start a new 45 minute cycle. When defrost override is active, the appropriate alarm will be indicated. If the run relay is de-energized during defrost, defrost will be terminated.

f. Defrost Termination

The defrost terminates with HR1 de-energizing. HR2 will turn off 2 seconds later. The defrost output will de-energize 5 seconds after HR1 to engage the clutch.

g. Remote Evaporator Defrost

Defrost for remote evaporators can be initiated two ways, the manual defrost switch located on the remote control box, or a solid state defrost timer that automatically initiates defrost at preset interval of 1-1/2, 3 or 6 hours. The defrost interval is selectable by placing jumper in the appropriate location, which is shown on the side of the timer. Defrost is terminated by one of two methods selected by a second jumper. The jumper should be in the 1 location, which is termination by opening of defrost thermostats. The alternate jumper position 20 is defrost termination after 20 minutes.

NOTE

The evaporator coil temperature must be below 35_F (1.7_C) before defrost can be initiated.

1.11.11 AUTO START/STOP OPERATION

Automatic start/stop is provided to permit starting/restarting of the diesel-driven compressor as required. This feature fully enables automatic control of the diesel engine starting and stopping. The main function of automatic engine cycling is to turn off the refrigeration system near setpoint to provide a fuel efficient temperature control system and to initiate a restart sequence after conditions are met. System shut-off is allowed only if the battery condition signal is good. The engine coolant temperature shall override the minimum off time and out-of-range condition to force engine restarting when the engine coolant temperature drops below 34_ F (1_C). A restart will also be initiated if the battery voltage falls below 11.0 Vdc. A restart will also be initiated if box temperature is more than 11_F (6_C) from set point.

a. Start/Stop – Continuous

NOTES

1. With software revisions 3.08 or 3.12 when configuration CNF11 is "ON" and setpoint is 32 to 42_ F (0 to 5.5_C), the unit is locked into continuous run. Start/Stop Continuous key is disabled in this setpoint range.
2. With software revision 3.15 or higher when configurations CNF3 & CNF11 are "ON" and setpoint is 32 to 42_ F (0 to 5.5_C), the unit is locked into continuous run. Start/Stop Continuous key is disabled in this setpoint range.

A key is provided to select between continuous run and auto start/stop operating mode. In the continuous run mode, the diesel engine will not shut down except for safeties or if the engine stalls. This function also apply to the operation of the electric motor.

b. Auto Mode Indicator

The "Auto Start/Stop" indicator is lit and ARL light will be on to indicate the start/stop mode has been selected.

c. Auto Start Failure

If the unit fails to start, shuts down on a safety, or fails to run for the minimum run time, three consecutive times, the "Auto Start/Failure" is activated.

d. Continuous Run Mode

In continuous run mode, the engine is started but not allowed to shut off except for safeties or if the engine stalls.

e. Auto Start Sequence

When the starting conditions are met, the start sequence will begin by energizing the run relay, and after 5 seconds energize the glow plug relay (GPR) to supply power to the glow plugs, and 5 seconds later the starter is energized. On initial power-up, the control will delay 5 seconds before the starting sequence begins. If the required glow time is zero, the control will energize the starter after a 10 second delay. The engine will crank for 10 seconds or until engine operation is sensed by the alternator signal. The glow relay will be de- energized after the auxiliary input is sensed on. A 15 second null cycle will elapse before subsequent start attempts. The run relay will remain energized until the next starting sequence.

Before the next starting sequence, the oil pressure is checked to determine if the engine is running and the alternator auxiliary has failed. For the second and third start attempts the glow time is increased by 5 seconds over the glow time of the first attempt listed below. The control allows three consecutive start attempts before the starting is locked out and the start failure alarm is activated.

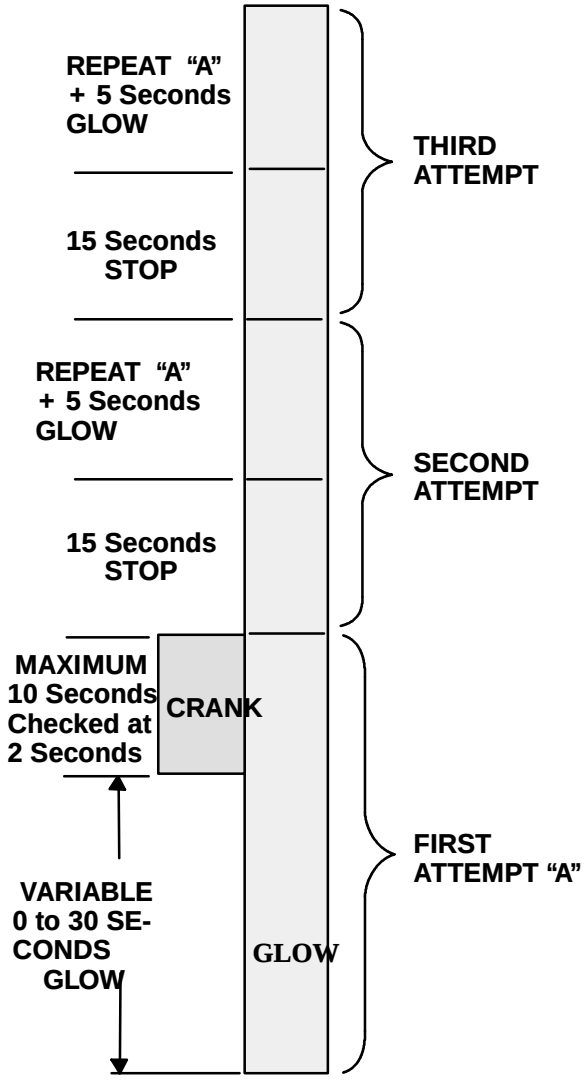


Figure 1-15. Auto Start Sequence

f. Variable Glow Time

The glow time for the first start attempt will vary in duration based on engine coolant temperature and the engine as follows:

Engine Coolant Temperature Glow Time		
Coolant Temperature	Glow Time in Seconds For	
	TV	DI
Less than 32_F (0_C)	15	55
33_F to 50_F (1_C to 10_C)	10	40
51_F to 77_F (11_C to 25_C)	5	25
Greater than 78_F (26_C)	0	10

The second and third start attempts have a glow time that is 5 seconds greater than the table amount. The glow time can be manually overridden through the function parameters. If the coolant temperature sensor is defective the control assume a temperature of less than 32_F (0_C) for the glow timing.

g. Minimum On Time

The engine is allowed to turn off only after a minimum of 4 or 7 minutes of run time with software revision less than 3.11. With software revision 3.11 or higher the on-time is 4 minutes.

The unit will not cycle off if the engine coolant temperature is less than 122_F (50_C) or the battery is not good. If the unit can not cycle off, it will operate normally in continuous mode. If all temperature probes fail and the setpoint is 10_F (−12_C) or less, the unit will not shut down.

The unit will shut down when the main compartment is within ¦ 0.5_F (¦ 0.3_C) of setpoint for setpoints in Perishable range or +0.5_F (+0.3) above setpoint for setpoints in Frozen range and the remote compartments are within ¦ 1_C of setpoint in Perishable range or +1_C of setpoint in Frozen range.

h. Minimum Off-Time

Keypad provision is provided to select the minimum off-time of 10, 20, 30, 45 or 90 minutes.

After the minimum off-time, the unit will restart for temperatures beyond ¦ 3.6_F (¦ 2.0_C) of setpoint for the Perishable range or above +3.6_F (+2.0_C) of setpoint for the Frozen range for all compartments.

The minimum off-time is overridden if the temperature is more than ¦ 11_F (¦ 6_C) from setpoint.

i. Battery Voltage

Provisions are made to sense when the battery is good. A good battery is defined as having 13.4v at 75_F. This condition is used to allow shut- off of the diesel engine.

If the battery voltage falls below 10v during glow cycle, the starter will not engage and the start sequence will continue, this is considered a failed start. The start sequence will be repeated until the unit starts or three consecutive start attempts have failed.

Table 1-7. Battery Voltages		
Message Display	Voltage Level	Description
LOW BATT AL4	10 or Less	Unit will shut down except during cranking.
	11 to 13.4	If the unit has cycled off in auto start/stop mode and battery voltage drops below 11.0 volts, the unit is automatically started to charge battery. Unit will operate until a battery voltage of 13.4 volts is obtained at which level unit will stop if temperatures are satisfied.
HI BATT AL5	17 or more	Unit will shut down.

j. Oil Pressure Signal

When the oil pressure switch is closed it shows that the engine is running and prevents engagement of the starter motor when operating in the auto mode.

k. Maximum Off-Time

Provision for a keypad selectable feature is provided which will cause the engine to be started 30 minutes after the engine has stopped regardless of the box temperature.

1.11.12 Remote Monitoring -- DataTrak (Optional)

The microprocessor controller is equipped with a RS232 communication port. This port can be used to communicate unit operating data to a mobile satellite transmitter. This information will then be relayed back to the office via a modem to a computer.

There are presently two (2) protocols supported. The protocol for the QualComm transmitter and Carrier Communication Protocol. The microprocessor will transmit in the Carrier, QualComm protocol if a data packet is requested.

1.12 SWITCHES AND CONTROLS

1.12.1 Introduction

Components required for monitoring and controlling the diesel engine – refrigeration system are located in the control box door and relay module. The water temperature sensor is located on top of the engine.

1.12.2 Control Box Door and Relay Module (See Figure 1-7 and Figure 1-9)

a. Gauges

1. Ammeter Gauge (A)

The d-c ammeter indicates the rate of charge or discharge of the battery charging system (including batteries), battery charging alternator and the voltage regulator.

b. Switches

1. Run-Stop Switch (RS)

When placed in the RUN position, this switch provides power to the microprocessor. The microprocessor performs a self-test (all segments of display are illuminated). Then Set Point and Box Temperature are displayed.

To stop the unit or remove power from the microprocessor, move the run-stop switch to the STOP position.

2. Manual Glow/Crank Switch (MGC)

The manual glow/crank switch when held in the GLOW position, energizes (approximately 7.5 amps per plug at 12 vdc) the glow plugs in the engine to pre-heat the combustion chamber. The CRANK position of the switch is used to manually engage the engine starter.

3. Selector Switch (SSW) – Model NDM

This switch is used to select mode of operation, either engine drive or standby electric motor drive. When this switch is placed in standby position, the electric motor will not start until the oil pressure safety switch (OP) opens.

1.12.3 Location of Engine Safety Devices

a. Oil Pressure Safety Switch (OP)

This switch, set to open below 15 ¦ 3 psig (1.0 ¦ 0.2 kg/cm@), will automatically stop the engine upon loss of oil pressure. See Figure 1-5 for location.

b. Water Temperature Sensor (WTS)

This sensor senses engine water temperature. The microprocessor will stop the unit when this temperature exceeds 230_F (110_C). If ambient temperature sensor (ATS) is at 120_F (49_C) or higher, the WTS limits are increased to 230 to 240_F for 5 minutes or immediately over 240_F (116_C). The sensor is located near the thermostat housing in the cylinder head.

1.13 ULTRAFRESH 2 TEMPERATURE CONTROL

NOTE

UltraFresh 2 can operate when only one compartment is being controlled.

UltraFresh 2 temperature control algorithm is a method of producing a reduced capacity state between heat and cool modes. This is done by combining a null pulse with either heat or cool. The capacity in this band can vary by adjusting the duty cycle of the null portion of operation. During this null operation heat and cool valves are opened simultaneously to reduce heating or cooling capacity.

UltraFresh 2 temperature control uses both supply and return air sensors to achieve control. If both probes are present and neither is defective or out of range the selected probe is the active probe. The controlling probe will switch depending on if the unit has pulled down to setpoint yet. During pulldown the controlling temperature is from the active probe. When not in pulldown mode the controlling temperature is supply air plus an integrator error which is based on the selected controlling (active) probe Again the 60_F exception occurs. When not in pulldown mode and the setpoint is >= 60_F the active probe is used for control and integration.

There are three possible modes for UltraFresh 2 control. These are heat, cool and null. To enter COOL the control temperature must be greater than or equal to 1_C above setpoint. To exit cool and enter NULL the control temperature must be less than 0.8_C above setpoint. To exit NULL and enter HEAT the control temperature must be more than or equal to 1_C below setpoint and to exit heat and enter NULL the control temperature must be less than 0.8_ below setpoint. (See Figure 1-16).

Null mode operates with a pulse, which combines cooling or heating with a null valve combination over a 10 second period. The null valve portion of the period is defined as HR1, HR3, and HR4 de-energized and HR2 energized. The calculated pulse percentage determines the type of pulse needed and the percentage of the 10 second period to pulse. At the end of each period the type of pulse and percentage is updated.

When in the null mode: The HEAT and COOL LCD's on the microprocessor display will blank out. The heat and cool lights (on light bar) will flash back and forth every 10 seconds or less.

UltraFresh 2 only operates when: Setpoint is in the perishable range above10_F (–12_C) and the unit is set for continuous run operation.

There is a delay of 10 seconds between de-energizing one unloader to de-energizing the other unloader under all operating conditions excluding engine starting.

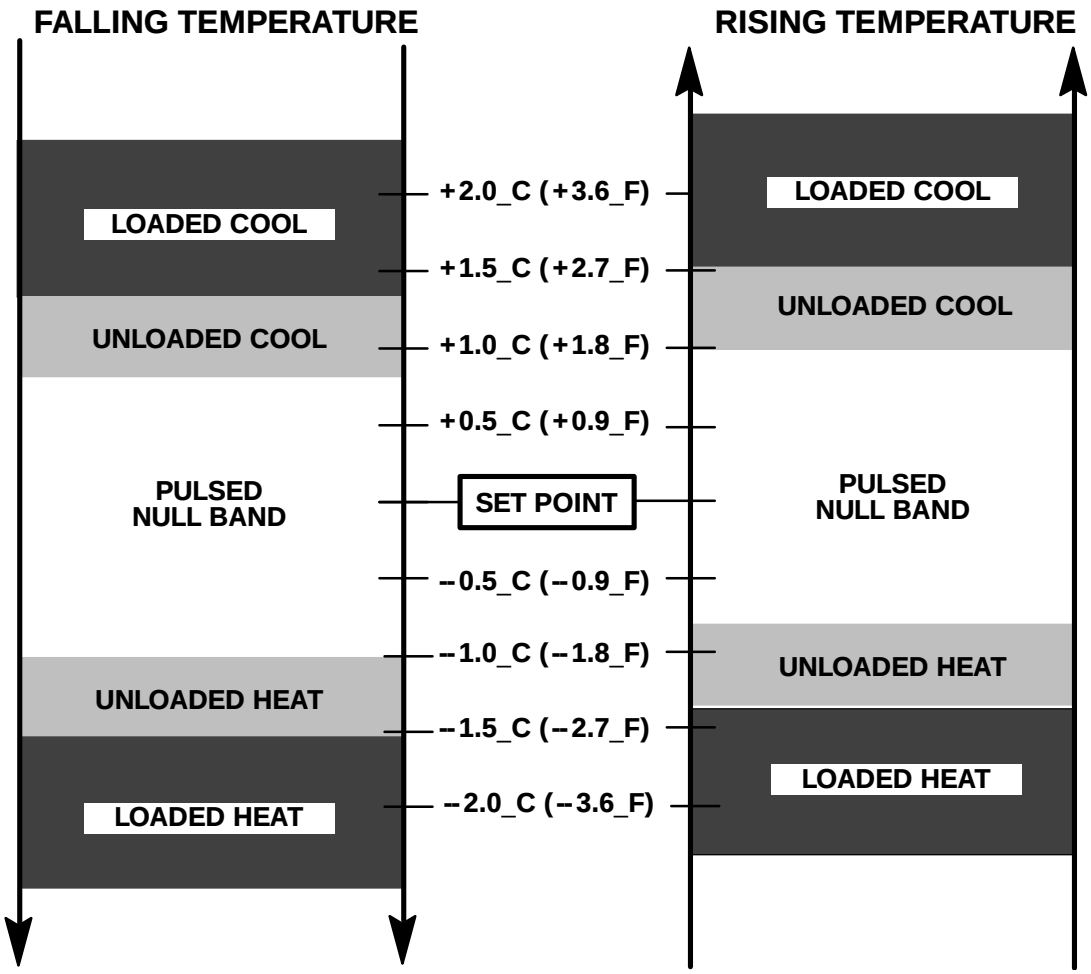


Figure 1-16 . UltraFresh 2 Temperature Control Operating Sequence

1.14 ULTRA FREEZE TEMPERATURE CONTROL WITH SOFTWARE 3.14 OR HIGHER

For frozen setpoints, a modified Ultra Fresh 2 temperature control is used to keep the unit from over cooling. Ultra Freeze operates the same as Ultra Fresh 2 except as noted in this section. Ultra Freeze control will be used anytime a frozen setpoint is selected in both diesel and standby units, in both continuous and start/stop operation. When in standard multi-temp temperature control Ultra Freeze is used to control the main compartment if it has a frozen setpoint selected. Ultra Freeze operates independently of the setting of CNF-15.

If Ultra Freeze is active the Ultra Fresh 2 unloader cooling logic is not invoked.

a. Ultra Freeze Offset

In continuous run a –3_F offset is added which will force the unit to control to 3_F below setpoint.

b. Ultra Freeze Start/Stop

In start/stop operation the unit's control will not have the 3_F offset and will control to setpoint by cycling the unit on and off according to the standard frozen mode start/stop startup and shutdown logic. The exception to this is when a low battery voltage or low engine coolant temperature defeats the normal shutdown logic, then the Ultra Freeze logic will control to the 3_F below setpoint offset.

c. Ultra Freeze Main Compartment Heat Mode

The main compartment is limited to 2 cylinder heat. If either or both of the remote compartments are enabled and the main compartment goes to heat mode the remotes are immediately forced to null mode, no heat or cool.

d. Ultra Freeze Main Compartment / Remotes Control

When the main compartment is either heating or cooling The remote compartments can override the unloaders. If a remote goes to cooling the unloaders will be de-energized. If a remote goes to heat mode the unloaders will be controlled by the main compartment, (unless another remote is cooling).

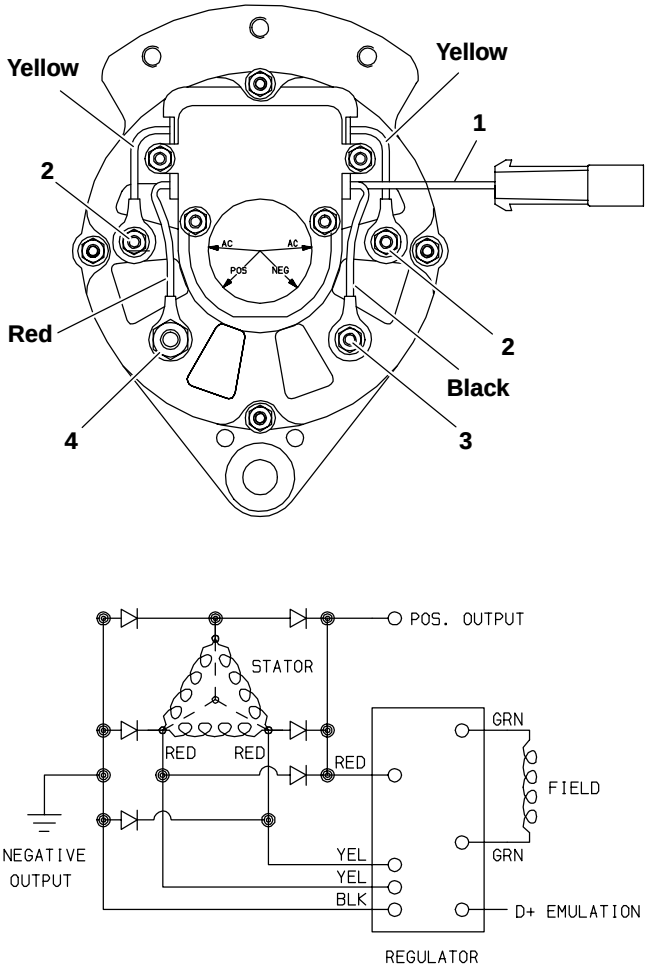
1.15 BATTERY CHARGING ALTERNATOR

1.15.1 Alternator Operation

CAUTION

Observe proper polarity when installing battery, negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator. As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the rectifier diodes in alternator.

The alternator converts mechanical and magnetic energy to alternating current (A.C.) and voltage, by the rotation of an electromagnetic field (rotor) inside a three phase stator assembly. The alternating current and voltage is changed to direct current and voltage, by passing A.C. energy through a three phase, full-wave rectifier system. Six silicon rectifier diodes are used.



1. D+ Emulation (Orange)
2. #10-24 AC Terminal
3. #10-24 Ground Screw
4. 1/4-20 Positive Output Cable

Figure 1-17. Alternator and Regulator P/N 30-00409

1.15.2 Integral Voltage Regulator Operation (12 volts dc)

The regulator is an all-electronic, transistorized device. No mechanical contacts or relays are used to perform the voltage regulation of the alternator system. The electronic circuitry should never require adjustment and the solid state active elements used have proved reliable enough to warrant a sealed unit. The system is temperature compensated to permit the ideal charging rate at all temperatures.

The regulator is an electronic switching device. It senses the system voltage level and switches the voltage applied to the field in order to maintain proper system voltage.

1.15.3 Alternator Service

The alternator brushes, regulator and bearings may be replaced if necessary.

1.16 REFRIGERANT CIRCUIT DURING COOLING (See Figure 1-18 or Figure 1-19)

When cooling, the unit operates as a vapor compression refrigeration system. The main components of the system are the (1) reciprocating compressor, (2) air-cooled condenser, (3) expansion valve, and (4) direct expansion evaporator.

The compressor raises the pressure and the temperature of the refrigerant and forces it into the condenser tubes. The condenser fan circulates surrounding air over the outside of the condenser tubes. The tubes have fins designed to improve the transfer of heat from the refrigerant gas to the air. This removal of heat causes the refrigerant to liquefy; thus liquid refrigerant leaves the condenser and flows through the solenoid valve SV-1 (normally open) and to the receiver.

The receiver stores the additional charge necessary for low ambient operation and for the heating and defrost modes. The receiver is equipped with a fusible plug which melts if the refrigerant temperature is abnormally high and releases the refrigerant charge.

The refrigerant leaves the receiver and flows through the manual receiver shutoff valve (King valve). The refrigerant then flows through the subcooler. The subcooler occupies a portion of the main condensing coil surface and gives off further heat to the passing air.

The refrigerant then flows through a filter-drier where an absorbent keeps the refrigerant clean and dry; and the electrically controlled liquid line solenoid valve (SV-2) which starts or stops the flow of liquid refrigerant.

In R-404A units the refrigerant flows to the “Liquid/suction” heat exchanger. Here the liquid is further reduced in temperature by giving off some of its heat to the suction gas.

The liquid then flows to an externally equalized thermostatic expansion valve which reduces the pressure of the liquid and meters the flow of liquid refrigerant to the evaporator to obtain maximum use of the evaporator heat transfer surface.

The refrigerant pressure drop caused by the expansion valve is accompanied by a drop in temperature; thus, the low pressure, low temperature fluid that flows into the evaporator tubes is colder than the air that is circulated over the evaporator tubes by the evaporator fan. The evaporator tubes have aluminum fins to increase heat transfer; therefore heat is removed from the air circulated over the evaporator. This cold air is circulated throughout the trailer to maintain the cargo at the desired temperature.

The transfer of heat from the air to the low temperature liquid refrigerant causes the liquid to vaporize. In R-22 units this low temperature, low pressure vapor returns to the compressor.

In R-404A units this low temperature, low pressure vapor passes through the “suction line/liquid line” heat exchanger where it absorbs more heat from the high pressure/high temperature liquid and then returns to the compressor.

The quench valve (R-22 Only) opens as required to maintain a 265 to 285_F (129 to 141_C) maximum discharge temperature.

The remote evaporator(s) refrigerant flows through the electrically controlled liquid line solenoid valve (LSV) which starts or stops the flow of liquid refrigerant.

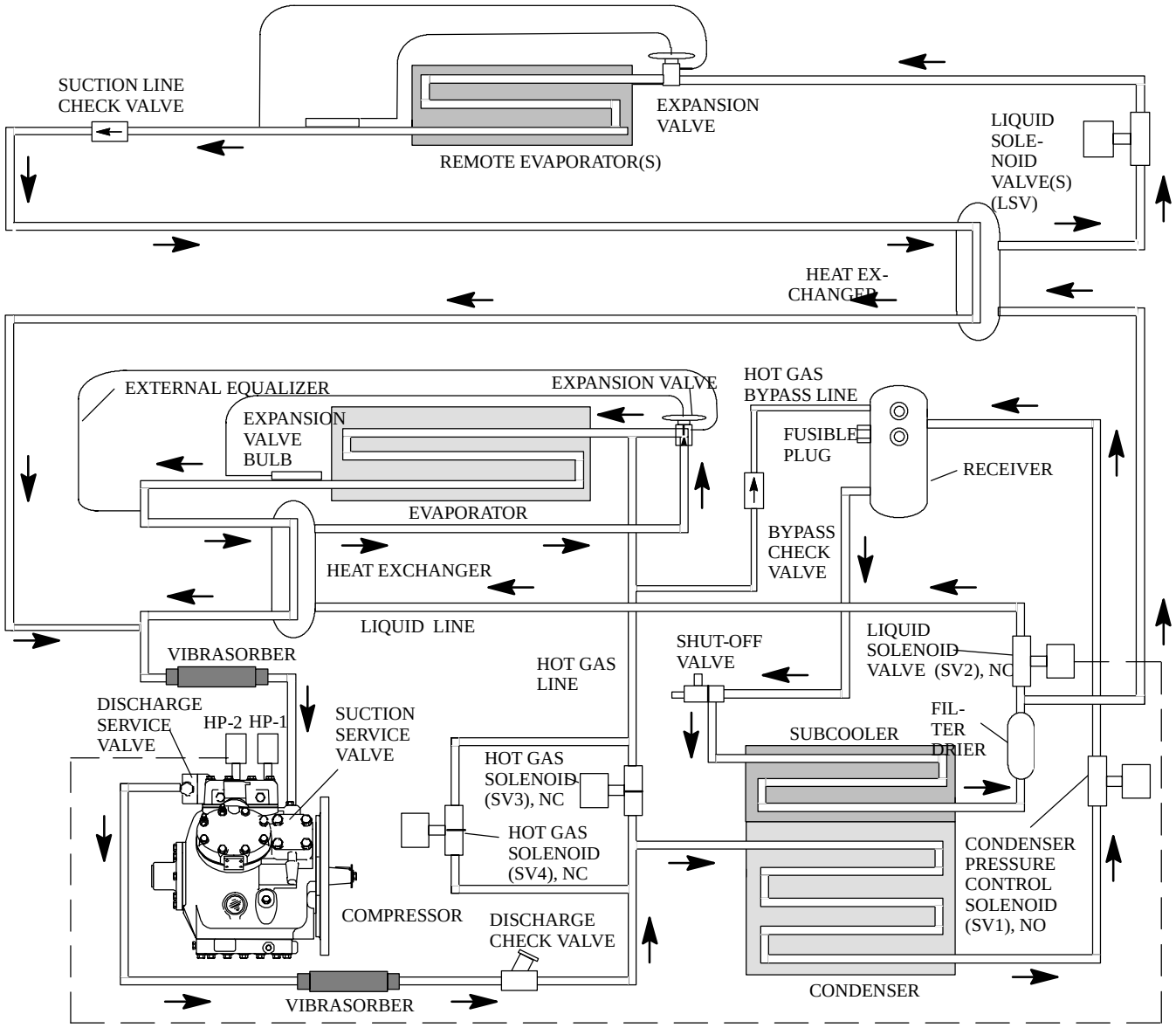


Figure 1-18. R-404A Refrigerant Circuit -- Cooling

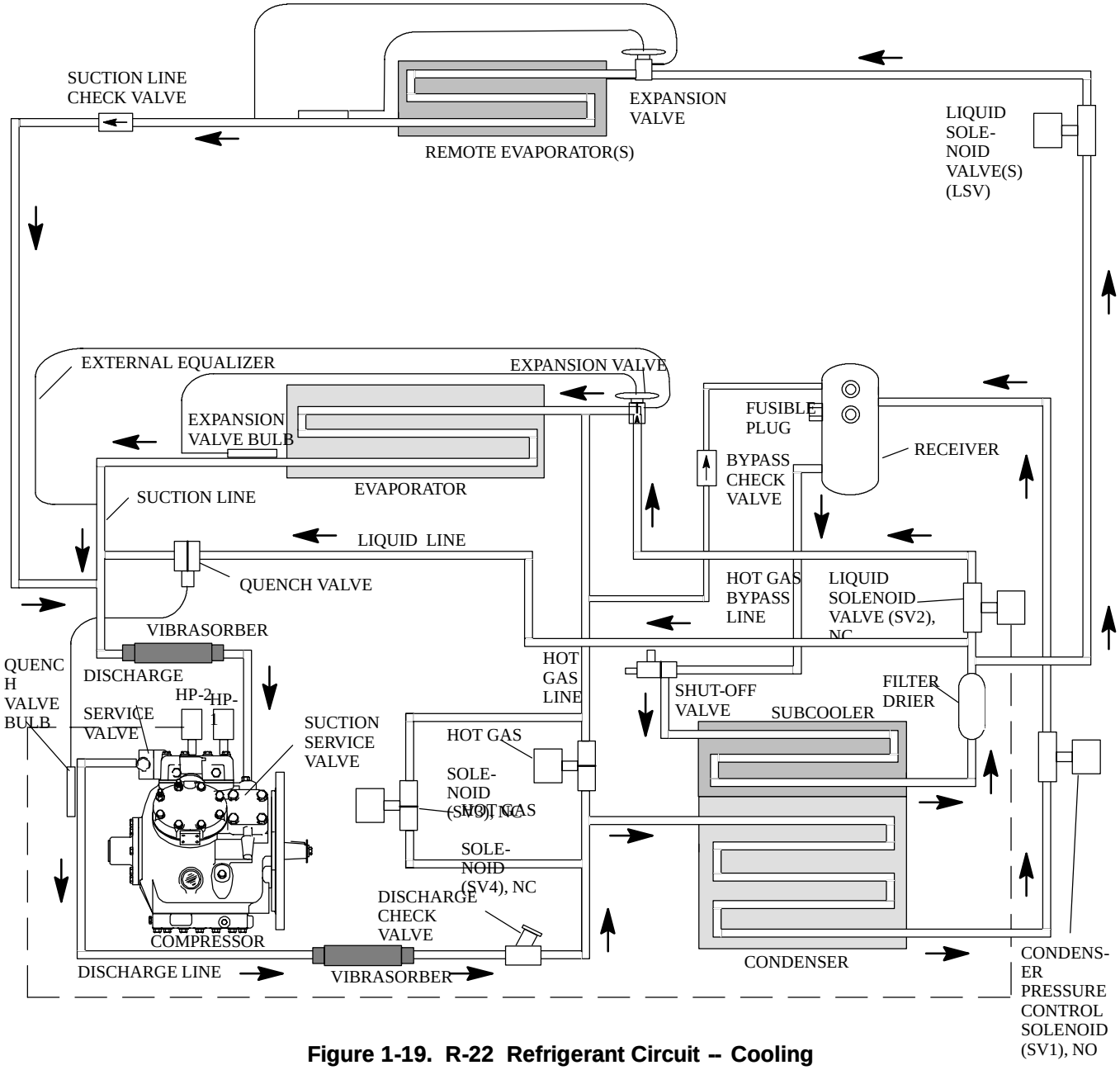


Figure 1-19. R-22 Refrigerant Circuit -- Cooling

1.17 REFRIGERANT CIRCUIT DURING HEATING AND DEFROSTING (See Figure 1-20 or Figure 1-21)

The unit will only hot gas heat when the controller is set above +10_F (−12.2_C) as the heat relays are electronically locked out with set points below +10_F (−12.2_C).

When vapor refrigerant is compressed to a high pressure and temperature in a reciprocating compressor, the mechanical energy necessary to operate the compressor is transferred to the gas as it is being compressed. This energy is referred to as the "heat of compression" and is used as the source of heat during the heating cycle.

The quench valve (R-22 Only) opens as required to maintain a 265 to 285_F (129 to 141_C) maximum discharge temperature.

1.17.1 Heating and Defrost

NOTES

1. Solenoid valve (SV-2) remains open during heating or defrosting to allow additional refrigerant to be metered into the hot gas cycle (through the expansion valve) providing additional heating capacity until de-energized by head pressure control switch HP-2.
2. SV-3 will open after a 60 second delay, if the difference between ambient and discharge temperatures exceeds 100_F (55.5_C). If the difference between ambient and discharge temperatures goes below 50_F (27.8_C) SV-3 will close.

When the controller calls for heating, hot gas solenoid valve (SV-4) opens and the condenser pressure control solenoid valve (SV-1) closes. The condenser coil then fills with refrigerant, and hot gas from the compressor enters the evaporator. Also the liquid line solenoid valve (SV-2) will remain energized (valve open) as the head pressure control switch (HP-2) will remain closed until the compressor discharge pressure increases to 300 psig (21.1 kg/cm@).

Switch HP-2 opens to de-energize the liquid line solenoid valve (SV-2) and the valve closes to stop the flow of refrigerant to the expansion valve.

When the compressor discharge pressure falls to cut-in setting (refer to section 1.4), pressure switch (HP-2) closes and in turn energizes the normally closed liquid solenoid valve (SV-2) which opens, allowing refrigerant from the receiver to enter the evaporator through the expansion valve.

When in engine operation and the discharge pressure exceeds pressure settings detailed in section 1.4, pressure cutout switch (HP-1) opens to de-energize the run relay coil (RR). When the RR coil is de-energized, the RR contacts open stopping the engine. The function of the hot gas bypass line is to raise the receiver pressure when the ambient temperature is low (below 0_F = −17.8_C) so that refrigerant flows from the receiver to the evaporator when needed.

1.17.2 Defrost with Greater Than 100_F (37.8_C) Ambient with Software less than 3.14 or 80_F (26.7_C) with Software 3.14 or higher

If the ambient is greater than 100_F (37.8_C) or 80_F (26.7_C) with Software 3.14 or higher the following stages are performed for defrost (Refer to Table 1-8). The first stage (Pump Down) runs for a minimum of thirty seconds and then checks the suction pressure. When the suction pressure is less than 10 PSIG, it will continue to stage 2. The total time in stage one cannot be greater than 330 seconds. If 330 seconds is reached stage two (Defrost Begins) will automatically be entered regardless of suction pressure. Stage 2 is defrost. Stage 3 (Defrost Termination) is the termination of defrost. When defrost is terminated SV4 will remain energized for 15 seconds. SV3 is locked out.

e. Electric Standby Motor Operation
(Refer to Section 6)

On electric standby motor operation HR4 relay is used to initiate a pump down cycle in heat or defrost.

Table 1-8. Stages for Defrost with Greater Than 100_F (37.8_C) or 80_F (26.7_C) Ambient with Software 3.14 or higher

STAGE	SV1 (HR1)	SV2 (HR4)	SV3 (HR3)	SV4 (HR2)	UR	UF	CLH (DR)
1	OPEN (De-energ)	CLOSED (Energ)	CLOSED (De-energ)	CLOSED (De-energ)	Energ	Energ	Energ (De-energ)
2	CLOSED (Energ)	HP2 Control (Energ)	CLOSED (De-energ)	OPEN (Energ)	De-energ	Energ	De-energ (Energ)
3	OPEN (De-energ)	OPEN (De-energ)	CLOSED (De-energ)	OPEN (Energ)	Energ	Energ	Energ (De-energ)
De-energ = De-energized Energ = Energized							

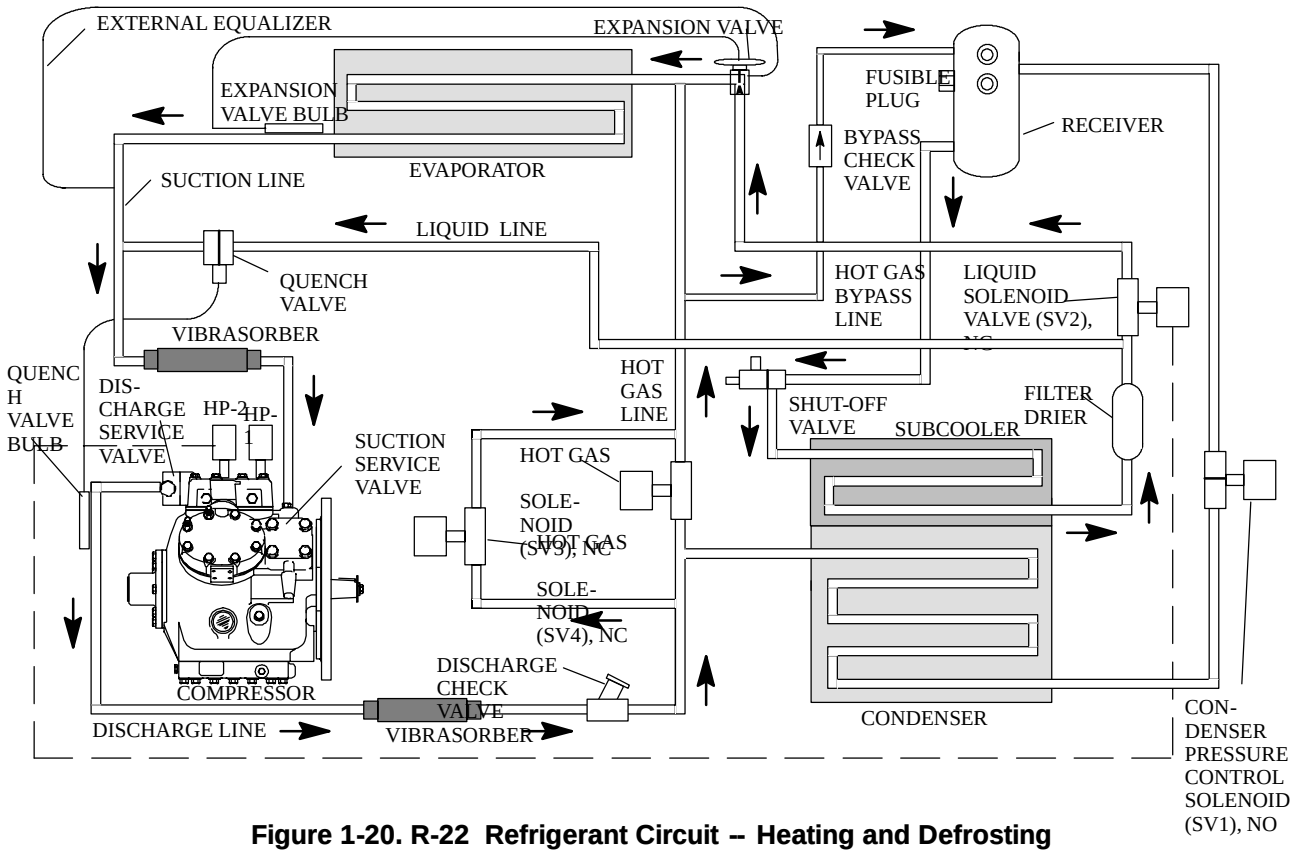


Figure 1-20. R-22 Refrigerant Circuit – Heating and Defrosting

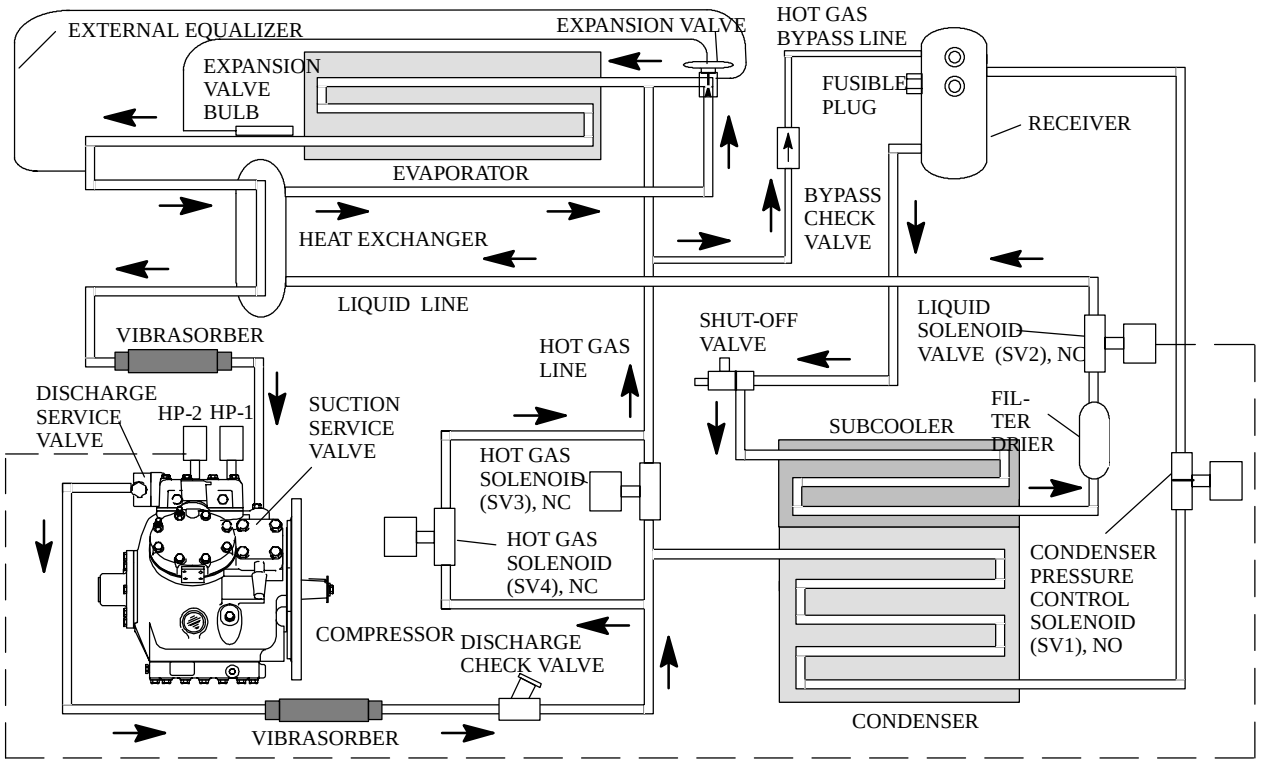


Figure 1-21. R-404A Refrigerant Circuit – Heating and Defrosting

SECTION 2

OPERATION

2.1 PRE-TRIP INSPECTION

a. Before Starting Engine

1. Drain water and sediment from fuel tank sump. Then fill tank with diesel fuel. (Refer to section 1.2)
2. Check radiator coolant level. (Add pre-mixed 50/50 permanent antifreeze-water as required.) USE ETHYLENE GLYCOL ONLY. (Refer to section 1.2)
3. Check evaporator and condenser coil for cleanliness.
4. Check engine lubrication and fuel filter, oil lines, and connections for leaks. (Tighten connections and/or replace gaskets.)
5. Check engine oil level. (Refer to section 1.2)
6. Check V-belts for proper tension, fraying or cracks. Adjust belt or replace.
7. Check battery terminals for cleanliness and tightness. Clean and coat with a mineral type grease (such as Vaseline).
8. Check condenser/evaporator fan shaft bearing for excessive play.
9. Check engine air cleaner for cleanliness and condition of air cleaner hose.
10. Check oil level in compressor sight glass.
11. Check defrost drain pan hoses. (Should be clear of debris.)
12. Check defrost air switch tubes and connections for breaks or air leaks.

b. After Starting Refrigeration Unit

1. Check water temperature. (Should be 150 to 180_F = 65 to 82_C.)
2. Check ammeter. (Should indicate +2 to +10 amps after start-up.)
3. Listen for abnormal noises. (Refer to section 3.3.7)
4. Check compressor oil level. (Refer to section 4.11)
5. Observe any signs of lube or fuel oil leaks.
6. Check radiator hoses for leaks.
7. Check refrigerant level. (Refer to section 4.8.f)
8. Feel filter-drier. Excessive temperature drop across drier indicates restriction. (Refer to section 4.14)
9. Check clutch/gearbox for excessive noise.
10. Start microprocessor Pre-trip Inspection. (Refer to Section 1.11.8)

2.2 STARTING AND STOPPING INSTRUCTIONS

WARNING

Under no circumstances should ether or any other starting aids be used to start engine.

NOTES

1. Whenever starting the engine, in order to reduce starter cranking and engine loads, the microprocessor always starts and operates in unloaded cool for the first 15 seconds. After first 15 seconds the microprocessor will allow the unit to operate normally, providing the coolant temperature is above 79_F (26_C).
2. With software revisions 3.08 or 3.12 when configuration CNF11 is "ON" and setpoint is 32 to 42_ F (0 to 5.5_C), the unit is locked into continuous run. Start/Stop Continuous key is disabled in this setpoint range.
3. With software revision 3.15 or higher when configurations CNF3 & CNF11 are "ON" and setpoint is 32 to 42_ F (0 to 5.5_C), the unit is locked into continuous run. Start/Stop Continuous key is disabled in this setpoint range.

2.2.1 AUTOMATIC START

a. Starting Instructions

1. Place the RUN-STOP switch in the RUN position. The microprocessor will perform a self-test (all display messages will appear in display window). Then setpoint and box temperature will be displayed.
2. The microprocessor will energize glow cycle (length of time depends on engine temperature) and start the engine.
3. To change the setpoint press the UP or DOWN arrow key and ENTER key.
4. Pressing the AUTO S/S–CONTINUOUS key changes the operation of the unit between automatic start/stop (unit will automatically start and stop in response to changing box temperature) or automatic start continuous run (unit will operate continuously after starting).

b. Stopping Instructions

Place RUN-STOP switch in the STOP position to stop unit.

2.2.2 MANUAL STARTING

a. Starting Instructions (Manual Starting)

1. To start the unit manually, place Run/Stop Switch to RUN position.
2. Press the AUTO S/S–CONTINUOUS key (if necessary) to erase START/STOP from the display.

3. Press the FUNCTION CHANGE key until AUTO OP or MAN OP appears on the display.

   a. If AUTO OP appears:

   (1) Press the ENTER key.

   (2) Press the UP or DOWN arrow key to make MAN OP appear on the display.

   (3) Press the ENTER key. The unit is in MANUAL START mode.

   b. If MAN OP appears:

   the unit is in MANUAL START mode.

4. Use the Manual Glow/Crank switch to start the unit refer to Table 2-1. Do not crank the engine for longer than 30 seconds continuously.

NOTE

Once the unit is programmed for Man OP, the AUTO S/S – CONTINUOUS key can be used to toggle between Auto Start/Stop and Continuous Run

Table 2-1. Manual Glow Time

Ambient Temperature	Glow Time in Seconds For	
	TV	DI
Less than 32_F (0_C)	15	55
33_F to 50_F (1_C to 10_C)	10	40
51_F to 77_F (11_C to 25_C)	5	25
Greater than 78_F (26_C)	0	10

b. Stopping Instructions

Place RUN-STOP switch in the STOP position to stop unit.

2.3 REMOTE COMPARTMENT OPERATION – With Remote Control Box Figure 2-1

a. To start remote evaporator, place the remote compartment switch in the ON position (See Figure 2-1).

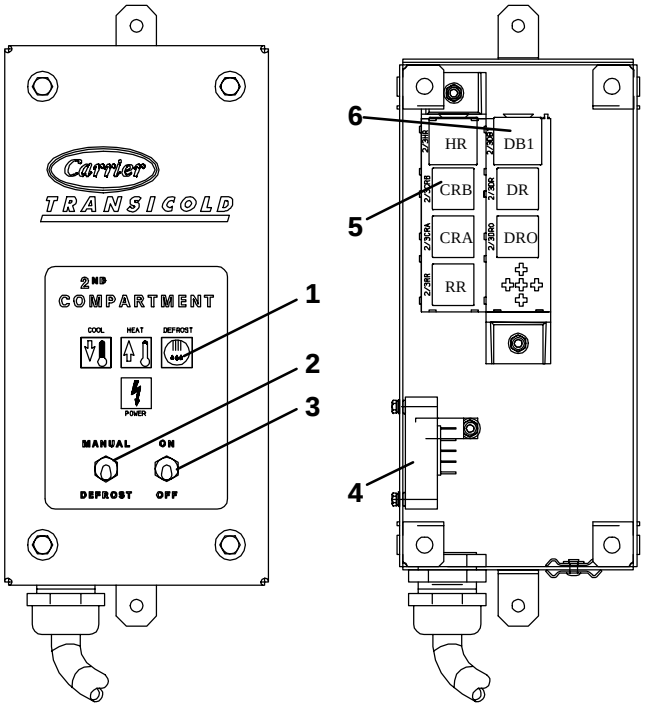
b. Set desired temperature using nosemount unit microprocessor controller (Refer to section 1.11).

c. The manual defrost switch and function lights for each compartment are on the remote control box.

d. Turn remote compartment switch OFF when remote evaporator is not required.

NOTE

For starting instructions on the nosemount unit refer to section 2.2.



1. Cool/Heat/Defrost/Power Lights
2. Manual Defrost Switch
3. Compartment ON-OFF Switch (2ST or 3ST)
4. Defrost Timer
5. Relays
6. Diode Block

Figure 2-1. Remote Control Box

2.4 COMPARTMENT OPERATION – With Optional Compartment Control Box Figure 2-2

a. Starting Compartment

1. Switch unit Engine-Start run switch ON. For starting instructions on the nosemount unit, refer to section 2.2.

2. Press system on/off button to ON position (see Figure 2-2).

3. Press required compartment on/off button to ON position (see Figure 2-2).

4. The unit will start and display DEF–– for 20 seconds. The last temperature setpoint and current compartment temperature will then be displayed.

5. Set required temperature by pressing up or down arrow keys as required.

6. Turn compartment button OFF when evaporator is not required.

b. To Set Pre-set Setpoint

1. Switch main on/off switch on the unit to ON. Press system on/off button to ON position (see Figure 2-2).

2. Press Carrier logo and the lock light will be displayed.

3. Press host compartment up arrow for 10 seconds. P1 will be displayed in all compartments.

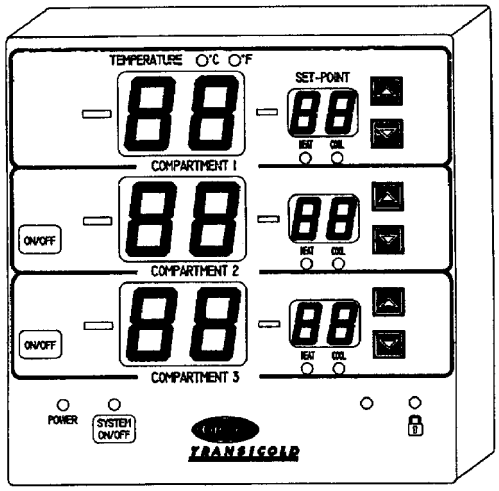


Figure 2-2. Compartment Control Box (Optional)

4. Set lowest setpoint temperature required.
5. Press Carrier logo and P2 will be displayed. Set next lowest temperature required up to five pre-set setpoints are available.
6. Pressing the second compartment up or down arrow will allow the lowest temperature required to be preset in the second compartment pressing the Carrier logo will then move on to the next lowest (up to five).
7. Press the Carrier logo for ten seconds and this will remove the lock light and store the pre-set setpoints in memory.

c. To Remove a Pre-set Setpoint

1. Start unit and press system on/off button to ON position (see Figure 2-2).
2. Press Carrier logo and the lock light will be displayed.
3. Press host compartment up arrow for 10 seconds. P1 will be displayed in all compartments.
4. Set temperature to lowest possible and OF will be displayed .
5. Press the up arrow on remote compartments will display the presets, take the temperature to the lowest possible and OF will be displayed.
6. Press the Carrier logo for ten seconds and the new information will be stored in memory.

2.5 MICROPROCESSOR CONTROLLER

NOTE

The Genesis nosemount unit microprocessor controller controls all compartments (Refer to section 1.11).

The Genesis microprocessor controller controls up to two remote compartments. The compartments are enabled by the compartment ON-OFF switch located on the remote control box. When a compartment is enabled the controller will maintain temperature based on setpoints entered via the keypad function parameter selections. Two temperature thermistor sensors are used to monitor the return air of each evaporator. Temperature control is achieved by switching between modes: cool, null and heat.

There are overriding factors which would prevent the remote compartments from cooling or heating. If the main compartment is in defrost then no cool or heat will be allowed in the remote compartments.

Start/Stop mode is also available for Multi compartment units. A remote compartment can override shutdown after the minimum run time if the temperature is not within ¦ 1.8_F (1_C) of setpoint. A remote compartment will cause the unit to restart after the minimum off time if temperature is more than ¦ 3.6_F (2_C) from setpoint. The minimum off time can be overridden if the remote temperature is more than 6_C from setpoint.

2.6 CONTROL CIRCUIT OPERATION

2.6.1 Introduction

NOTE

The schematic in this manual has map coordinates added to the margins. For example, to locate the ammeter (A) on the schematic, it would follow the component designation by the designation (I2). This would indicate that it is closest to lines I and 2 on the schematic. These locations have been added to the legend.

The controller boards shown on the electrical schematic (Figure 5-1) that interface with unit components are the analog interface or processor board on the left and the relay module on the right.

Connections to these boards are made through 3 multiple-pin plug connectors HC, HC2, & MP. The address system (example HCD2-MPW2) indicates a wire between plug HC, pin D2 and microprocessor MP & pin W2.

The processor board connections are mainly inputs and outputs for control switches, temperature sensors, safety, and auto start functions that control the operation of the unit. The processor board also controls the operation of the relay board through plug connections.

The relay module, which contains plug-in interchangeable relays provides the microprocessor with a means for switching the unit components to achieve a desired operating mode.

2.6.2 Cooling

There are two control ranges, Frozen and Perishable. The Frozen range is active with set points at or *below +10*_F *(−12_C*) and the Perishable range is active at set points *above +10*_F *(−12_C*).

The controller automatically selects the mode necessary to maintain box temperature at set point (See Figure 2-4 or Figure 2-5).

When the unit is running in loaded cool and with the evaporator coil temperature below 40_F (4.4_C) to close at least one defrost termination thermostat, a pre-trip may be initiated by depressing the PRETRIP key. The

operator now may verify the pre-trip sequence. (Refer to Section 1.11.8)

As the trailer temperature falls closer to set point, the controller will shift the operation from loaded cool to unloaded cool to further reduce cooling capacity. To do this, the microprocessor will pull terminals X2 or X2 & X3 low, completing the ground path for the unloader relays (UFR & URR). The coils energizes to close the UFR & URR contacts. One or both unloaders (UF and UR) may energize to unload the compressor (Refer to Section 1.10).

For setpoints above 10_F (−12_C) and with decreasing temperature, the unit will shift to unloaded heat.

For setpoints below 10_F (−12_C) hot gas heating is locked out. Electric heat may be allowed depending on remote status. Therefore, it is possible for the box temperature to fall below setpoint in the frozen range.

Unit will remain in various stages of heating until the box temperature increases enough to place the unit in the unloaded cool mode. As the box temperature increases, the unit will shift to loaded cool.

2.6.3 Pulsed Cooling

The liquid solenoid valves (2/3LSV) for compartments 2 and 3 are opened and closed to pulse cool, according to the timing diagram. (See Figure 2-3) There is no pulsed cooling for the main compartment.

When any compartment is in cool band +1.3_*C* above set point (regardless of setpoint), and any remote compartment (with a perishable setpoint) is in the pulsed cool band it will use pulsed cooing. (See Figure 2-4)

2.6.4 Ultrafreeze

With software 3.11 or higher for frozen setpoint, under mode has been replaced by Ultrafreeze. Refer to section 1.14 for Ultrafreeze.

In Ultrafreeze mode, anytime the main compartment is in null or heat band, and a remote compartment requires cooling, the main compartment will shut down by energizing HR4 and de-energizing HR1, HR2 and HR3. During this period the Ultrafreeze control algorithm will continue to operate so that the main compartment is turned back on, it will continue from the appropriate control point.

2.6.5 Heating

NOTES

1. SV-3 will open after a 60 second delay, if the difference between ambient and discharge temperatures exceeds 100_F (55.5_C). If the difference between ambient and discharge temperatures goes below 50_F (27.8_C) SV-3 will close.
2. Whenever the unit shifts to heat or defrost, HR1 and HR2 energize simultaneously. When switching from heat (or defrost) to cool, HR1 de-energizes 2 seconds before HR2. This allows time for SV-1 to open and clear the condenser of liquid before SV4 closes. This will eliminate any high pressure buildup which could occur. During this time, only on the remote light bar, the heat and cool lights will be on together. The heat and cool display on the control panel change immediately.
3. Loaded Heat is locked out for 5 minutes after switching from cool to heat.

Refer to section 1.17 for description on heating cycle.

The unit will only hot gas heat when the controller is set above +10_F (−12_C) as the heat relays are electronically locked out with set points at or below +10_F (−12_C). Electric heat may be allowed depending on remote status.

The controller automatically selects the mode(s) necessary to maintain box temperature at set point. The heating modes are as follows with descending temperatures:

(a) Unloaded Heating, (b) Loaded Heating

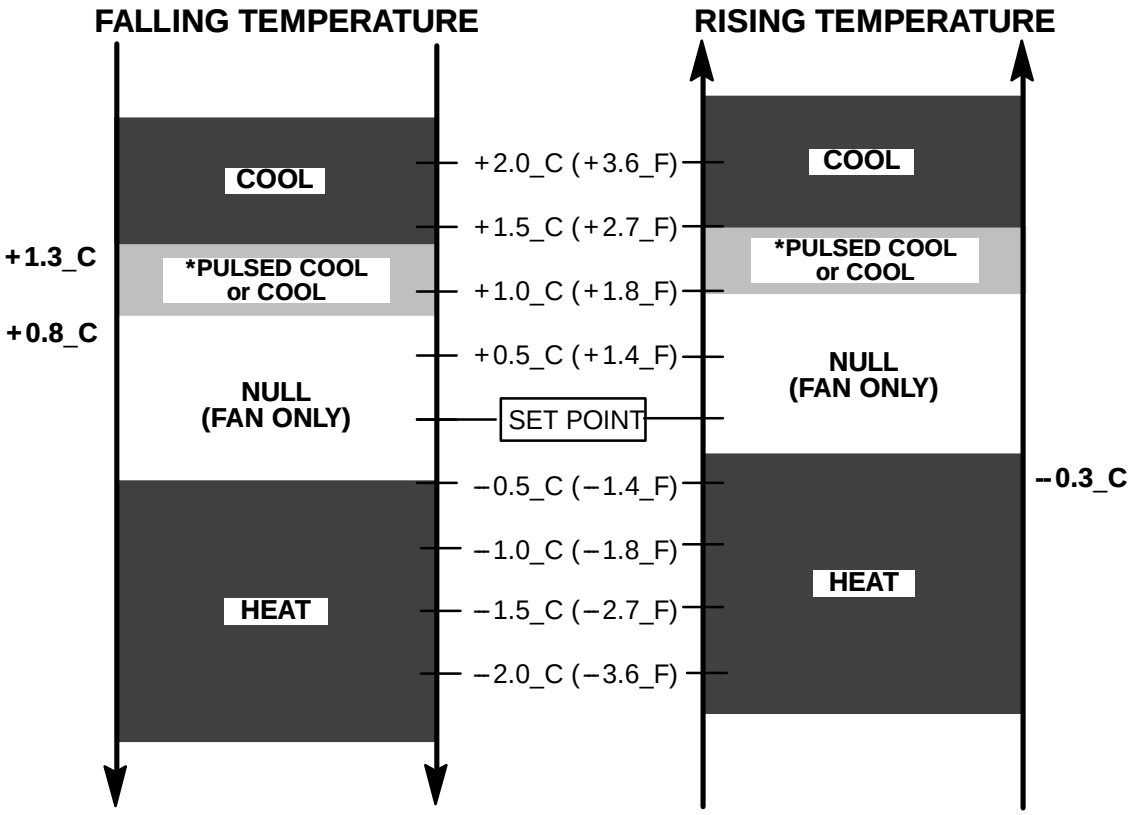
The controller will shift the unit into unloaded heat when the trailer temperature falls below set point. The microprocessor pulls terminals N1, X1 and S2 low to complete the ground paths for the heat relays (HR1 and HR2). When these relays energize, several things happen. This opens the (N.C.) contacts to the cool light and solenoid valve (SV2). SV2 now operates in conjunction with the head pressure control switch (HP2). (Refer to section 1.17)

Also, HR1 closes a set of normally open contacts to energize solenoid valve SV1 to close the condenser outlet line.

Energizing HR2 closes two sets of N.O. contacts. Solenoid SV4 energizes and opens to allow hot refrigerant vapor to enter the evaporator (section 1.17). The other set of HR2 contacts supply power to the heat light on light bar.

<table>
<tr><th>Time</th><th colspan="4">30 SECONDS</th></tr>
<tr><td>Compartment 2</td><td colspan="2">10 seconds
No Refrigerant Flow</td><td>5 Seconds
Refrigerant
Flow</td><td colspan="2">15 seconds
No Refrigerant Flow</td></tr>
<tr><td>Compartment 3</td><td colspan="3">15 seconds
No Refrigerant Flow</td><td>5 Seconds
Refrigerant
Flow</td><td>10 seconds
No Refrigerant Flow</td></tr>
</table>

Figure 2-3. Pulsed Cooling Timing Diagram



***There is no Pulsed Cool in the main compartment. Only 2nd & 3rd compartment have Pulsed Cool.**

Figure 2-4. Perishable Range Temperature Controller Operating Sequence – Controller Set Point Above –12_C (+10_F)

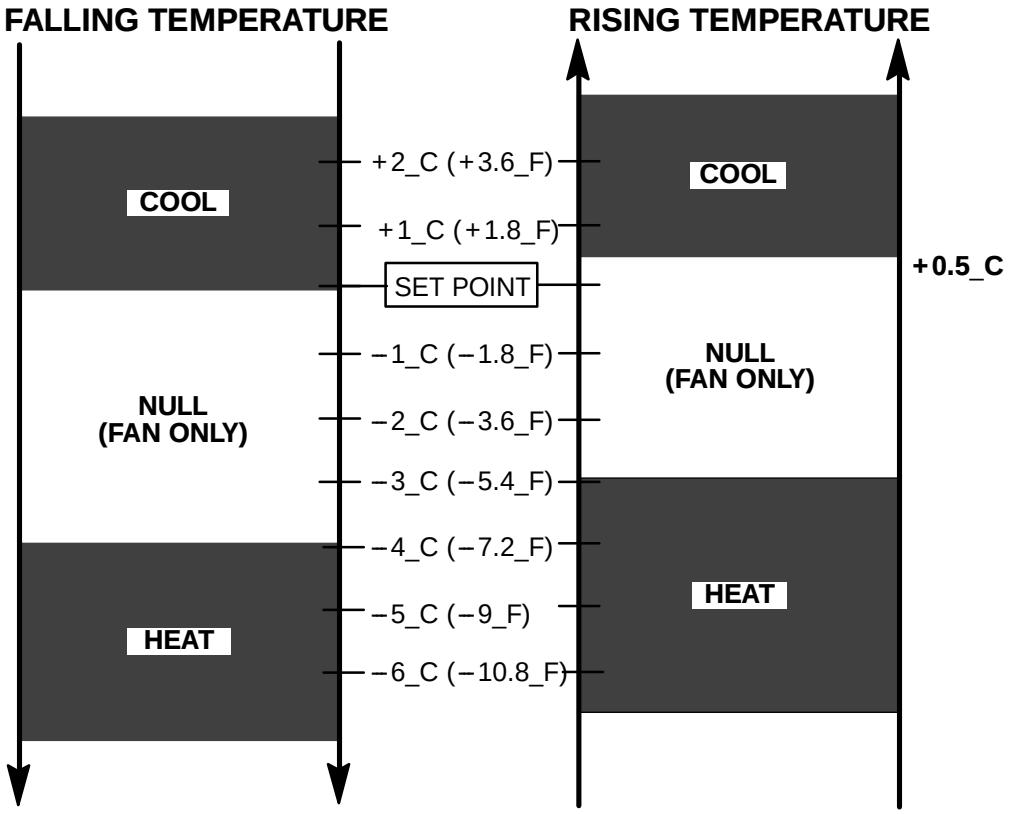


Figure 2-5. Frozen Range Temperature Controller Operating Sequence – Controller Set Point Below –12_C (+10_F)

2.6.6 Defrost

Refer to sections 1.11.10 and 1.17 for the heat and defrost cycle.

The defrost mode may be initiated by three different ways if the evaporator coil is below 35_F (1.7_C). (Refer to section 1.4)

Method one to initiate defrost is by pressing the MANUAL DEFROST key.

Method two is that defrost may be initiated automatically at preset intervals by the defrost timer in the microprocessor. (Refer to section 1.11.2). The manual defrost key and defrost timer are part of the microprocessor and are not shown on the schematic.

On the host unit a third means of defrost initiation is by the defrost air switch (DA). The switch is an air pressure differential switch which measures air pressure differential across the evaporator coil and initiates the defrost cycle when the air pressure differential increases enough to close the DA contacts, such as would happen when excessive frost builds up on the evaporator coil surface.

When the defrost air switch contacts close, there is a 12 vdc potential to terminal K1 on the microprocessor. The microprocessor looks for voltage at terminal K2. Voltage at K2 indicates that at least one defrost termination thermostat is closed. The unit will shift to the defrost mode if voltage is present at K2.

If both defrost thermostats (klixons) are open (no voltage at K2), defrost cannot be initiated by any means.

In defrost the microprocessor pulls terminals N1 and X1 low to shift the unit into heat. The processor also pulls terminal W2 low to energize the defrost relay coil. This closes the N.O. defrost relay contacts to energize the defrost light on the remote light bar. The defrost and heat display will also be illuminated.

Also N.C. defrost relay contacts open to de-energize the clutch (CLH) to stop the evaporator and condenser fans.

The unit will remain in defrost until both defrost termination thermostats open to remove voltage from the defrost relay. If the thermostats fail to open in 45 minutes, the microprocessor will terminate defrost and shift between normal control and defrost at 1 1/2 hour intervals. This will also occur if the defrost air switch is stuck closed.

If the problem corrects itself, (thermostats opens for example), the unit will automatically resume its normal functions).

The defrost termination starts with HR1. HR2 will turn off 2 seconds later. The defrost output will de-energize 5 seconds after HR1.

Table 2-2. Two Compartment Multi-Temp Logic Control

Compartment Need		Host Heat	Host Cool	1HVR EHR1	2CR LSV1	2HR EHR2	UNLOADERS		
Host	Remote						UF	UR R22	UR R404A
Cool	Cool	0	X	0	X	0	M	M	M
Cool	Heat	0	X	0	0	X	M	M	X
Cool	Null	0	X	0	0	0	M	M	M
Cool	Defrost	0	X	0	0	X	M	M	X
Heat	Cool	Electric	0	X	X	0	M	M	X
Heat	Heat	Hot Gas	0	0	0	X	M	0	0
Heat	Null	Hot Gas	0	0	0	0	M	0	0
Heat	Defrost	Hot Gas	0	0	0	X	M	0	0
Defrost	Null	Hot Gas	0	0	0	0	M	0	0
Null	Cool	0	0	0	X	0	M	M	M
Under (Frozen)	Cool	Electric	0	X	X	0	M	M	X
Under (Frozen)	Heat	0	X	0	0	X	M	M	X
Under (Frozen)	Defrost	0	X	0	0	X	M	M	X
Under (Frozen)	Null	Electric	X	0	0	0	M	M	X
Ultra Freeze	Cool	0/Hot Gas	0	0	X	0	M	M	X
Ultra Freeze	Heat	0/Hot Gas	0	X	0	X	M	M	X
Ultra Freeze	Defrost	0/Hot Gas	0	0	0	X	M	M	X

X = Output is ON – Energized
O = Output is OFF – De-energized
C = Cycling
M = Control both suction pressure and temperature demand
Engine Speed is 1700 RPM (single speed)
Under = Under setpoint with setpoint at or below +10_F (–12_C).

NOTE: With software 3.14 or higher there is no Under mode. These unit have Ultra Freeze refer to section 1.14.

Table 2-3. Three Compartment Multi-Temp Logic Control												
Compartment Need			Host Heat	Host Cool	1HVR EHR1	2CR LSV1	2HR EHR2	3CR LSV2	3HR EHR3	Unloaders		
Host	Remote 1	Remote 2								UF	UR R22	UR R404A
Cool	Cool	Cool	0	X	0	X	0	X	0	M	M	M
Cool	Cool	Heat	0	X	0	X	0	0	X	M	M	M
Cool	Cool	Null	0	X	0	X	0	0	0	M	M	M
Cool	Null	Defrost	0	X	0	0	0	0	X	M	M	M
Cool	Heat	Cool	0	X	0	0	X	X	0	M	M	M
Cool	Heat	Heat	0	X	0	0	X	0	X	M	M	X
Cool	Heat	Null	0	X	0	0	X	0	0	M	M	M
Cool	Null	Cool	0	X	0	0	0	X	0	M	M	M
Cool	Null	Heat	0	X	0	0	0	0	X	M	M	M
Cool	Null	Null	0	X	0	0	0	0	0	M	M	M
Cool	Defrost	Null	0	X	0	0	X	0	0	M	M	M
Heat	Cool	Cool	Electric	0	X	X	0	X	0	M	M	M
Heat	Cool	Heat	Electric	0	X	X	0	0	X	M	M	X
Heat	Cool	Null	Electric	0	X	X	0	0	0	M	M	M
Heat	Null	Defrost	Hot Gas	0	0	0	0	0	X	M	0	0
Heat	Heat	Cool	Electric	0	X	0	X	X	0	M	M	X
Heat	Heat	Heat	Hot Gas	0	0	0	X	0	X	M	0	0
Heat	Heat	Null	Hot Gas	0	0	0	X	0	0	M	0	0
Heat	Null	Defrost	Hot Gas	0	0	0	0	0	X	M	0	0
Heat	Null	Cool	Electric	0	X	0	0	X	0	M	M	M
Heat	Null	Heat	Hot Gas	0	0	0	0	0	X	M	0	0
Heat	Null	Null	Hot Gas	0	0	0	0	0	0	M	0	0
Heat	Null	Defrost	Hot Gas	0	0	0	0	0	X	M	0	0
Heat	Defrost	Null	Hot Gas	0	0	0	X	0	0	M	0	0
Defrost	Null	Null	Hot Gas	0	0	0	0	0	0	M	0	0
Null	Cool	Cool	0	0	0	X	0	X	0	M	M	M
Null	Cool	Heat	0	0	0	X	0	0	X	M	M	M
Null	Cool	Null	0	0	0	X	0	0	0	M	M	M
Null	Heat	Cool	0	0	0	0	X	X	0	M	M	M
Null	Null	Cool	0	0	0	0	0	X	0	M	M	M
Under	Cool	Cool	Electric	0	X	X	0	X	0	M	M	M
Under	Cool	Heat	Electric	0	X	X	0	0	X	M	M	X
Under	Cool	Null	Electric	0	X	X	0	0	0	M	M	M
Under	Heat	Cool	Electric	0	X	0	X	X	0	M	M	X
Under	Heat	Heat	0	X	0	0	X	0	X	M	M	X
Under	Heat	Null	Electric	X	X	0	X	0	0	M	M	X
Under	Null	Cool	Electric	0	X	0	0	X	0	M	M	M
Under	Null	Heat	Electric	X	X	0	0	0	X	M	M	X
Under	Null	Null	Electric	X	X	0	0	0	0	M	M	M
Under	Null	Defrost	Electric	X	X	0	0	0	X	M	M	X
Under	Defrost	Null	Electric	X	X	0	X	0	0	M	M	X

This Table is continued on the next page.

Table 2-3. Three Compartment Multi-Temp Logic Control												
Compartment Need			Host Heat	Host Cool	1HVR EHR1	2CR LSV1	2HR EHR2	3CR LSV2	3HR EHR3	Unloaders		
Host	Remote 1	Remote 2								UF	UR R22	UR R404A
UltraFreeze	Cool	Cool	0	0	0	X	0	X	0	M	M	M
UltraFreeze	Cool	Heat	0	0	0	X	0	0	X	M	M	X
UltraFreeze	Cool	Null	0	0	0	X	0	0	0	M	M	M
UltraFreeze	Heat	Cool	0	0	0	0	X	X	0	M	M	X
UltraFreeze	Heat	Heat	0	X	0	0	X	0	X	M	M	X
UltraFreeze	Heat	Null	0	X	0	0	X	0	0	M	M	X
UltraFreeze	Null	Cool	0	0	0	0	0	X	0	M	M	M
UltraFreeze	Null	Heat	0	X	0	0	0	0	X	M	M	X
UltraFreeze	Null	Null	0	X	0	0	0	0	0	M	M	M
UltraFreeze	Null	Defrost	0	0	0	0	0	0	X	M	M	X
UltraFreeze	Defrost	Null	0	0	0	0	X	0	0	M	M	X

X = Output is ON – Energized
O = Output is OFF – De-energized
C = Cycling
M = Control both suction pressure and temperature demand
Engine Speed is 1700 RPM (single speed)
Under = Under setpoint with setpoint at or below +10_F (–12_C).

NOTE: With software 3.14 or higher there is no Under mode. These unit have UltraFreeze refer to section 1.14.

SECTION 3

TROUBLESHOOTING

CAUTION

Under no circumstances should anyone attempt to service the microprocessor!(see section 4.27) Should a problem develop with the microprocessor, contact your nearest Carrier Transicold dealer for replacement.

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1 DIESEL ENGINE **3.1.1 Engine Will Not Start**		
Starter motor will not crank or low cranking speed	Battery insufficiently charged Battery terminal post dirty or defective Bad electrical connections at starter Starter motor malfunctions Starter motor solenoid defective Open starting circuit Incorrect grade of lubricating oil	Check Check Check 3.1.3 Engine Manual 3.1.4 1.2
Starter motor cranks but engine fails to start	No fuel in tank Air in fuel system Water in fuel system Plugged fuel filters Plugged fuel lines to injector (s) Fuel control operation erratic Glow plug(s) defective Fuel solenoid defective Fuel pump (FP) malfunction	Check 4.2 Drain Sump Replace Check Engine Manual 4.3.6 Engine Manual 4.2
Starter cranks, engages, but dies after a few seconds	Engine lube oil too heavy Voltage drop in starter cable(s)	1.2 Check
3.1.2 Engine Starts Then Stops		
Engine stops after several rotations	Fuel supply restricted No fuel in tank Leak in fuel system Faulty fuel control operation Fuel filter restricted Injector nozzle(s) defective Injection pump defective Air cleaner or hose restricted Safety device open Fuel solenoid defective Fuel pump (FP) malfunction	Check Check Check Engine Replace Engine Manual Engine Manual 4.3.3 1.8 Engine Manual 4.2
3.1.3 Starter Motor Malfunction		
Starter motor will not crank or turns slowly	Battery insufficiently charged Battery cable connections loose or oxidized Battery cables defective Starter brushes shorted out Starter brushes hang up or have no contact Starter solenoid damaged Run-Stop switch defective Engine lube oil too heavy	Check Check Replace Engine Manual Engine Manual Engine Manual Replace 1.2

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.1.3 Starter Motor Malfunction (CONTINUED)		
Starter motor turns but pinion does not engage	Pinion or ring gear obstructed or worn	Clean both, remove burrs, or replace; apply grease
Starter motor does not disengage after switch was depressed	Run-Stop switch defective Starter motor solenoid defective	Replace Engine Manual
Pinion does not disengage after engine is running	Defective starter	Engine Manual
3.1.4 Malfunction In the Engine Starting Circuit		
No power to starter motor solenoid (SS)	Battery defective Loose electrical connections	Check Tighten
Fuel solenoid does not energize or does not remain energized	Battery defective Loose electrical connections Oil pressure safety switch (OP) defective Run relay (RR) defective Water temperature sensor (WTS) defective Fuel solenoid defective Run-Stop switch defective	Check Tighten Replace Replace Replace Engine Manual Replace
3.2 ALTERNATOR (Low Voltage)		
Alternator fails to charge	Limited charging system operating time Battery condition Alternator belt loose/broken Loose, dirty, corroded terminals, or broken leads Excessively worn, open or defective brushes Open blocking diode Regulator faulty Open isolation diode Open rotor (field coil)	Check Check 4.4 Check/Repair Check Check Check Check Replace
Low or unsteady charging rate	Alternator belt loose Loose, dirty, corroded terminals, or broken leads Excessively worn, sticky or intermittent brushes Faulty regulator Grounded or shorted turns in rotor Open, grounded or shorted turns in stator	4.4 Check/Repair Check Check Check Replace
Excessive charging rate (as evidenced by battery requiring too frequent refilling) or charge indicator shows constant “charge with engine idling”	Regulator leads loose, dirty, corroded terminals, or wires broken Defective regulator	Clean/Repair Check
Noisy alternator	Defective or badly worn V-belt Worn bearing(s) Misaligned belt or pulley Loose pulley	4.4 Replace 4.4 Tighten

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3 REFRIGERATION **3.3.1 Unit Will Not Cool**		
Diesel engine	Malfunction(s)	3.1
Compressor malfunction	Compressor drive defective Compressor defective	4.10 4.10
Refrigeration system	Defrost cycle did not terminate Abnormal pressure Solenoid valve malfunction	3.3.5 3.3.6 3.3.11
3.3.2 Unit Runs But Has Insufficient Cooling		
Compressor	Compressor valves defective Unloader malfunction	4.10 4.12
Refrigeration system	Abnormal pressure Unloader malfunction Expansion valve malfunction No or restricted evaporator airflow	3.3.6 4.12 3.3.10 3.3.9
Engine does not develop full rpm	Engine malfunction	3.1
3.3.3 Unit Operates Long or Continuously in Cooling		
Trailer	Hot Load Defective box insulation or air leak Poor air distribution (Product Loading)	Allow time to pull down Correct Correct
Refrigeration system	Abnormal pressure Temperature controller malfunction	3.3.6 3.3.8
Compressor	Defective Unloader malfunction	4.10 4.12
3.3.4 Unit Will Not Heat or Has Insufficient Heating		
Refrigeration	Head pressure control switch (HP-2) defective Abnormal pressure Temperature controller malfunction Solenoid valve malfunction 1/4” check valve (bypass) defective	4.15 3.3.6 3.3.8 3.3.11 4.13
Compressor	Compressor drive defective Compressor defective	4.10 4.10
Engine does not develop full rpm	Engine malfunction	3.1

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.5 Defrost Cycle Malfunction		
Will not initiate defrost automatically	Defrost air switch (DA) out of calibration Defrost thermostats (DTT) open or defective Defrost air switch (DA) defective Loose terminal connections Air sensing tubes defective or disconnected Remote Defrost timer defective	4.20 4.19 4.19 & 4.20 Tighten Check Check
Will not initiate defrost manually	Microprocessor defective Loose terminal connections Defrost thermostats (DTT) open or defective Glow/Crank switch defective	Replace Tighten Replace Replace
Initiates but does not defrost	Solenoid valve malfunction Defrost relay (DR) defective Clutch/Gearbox defective	3.3.11 Replace Replace
Frequent defrost	Defrost air switch (DA) out of adjustment Wet load Air leakage	4.19 & 4.20 Normal Check
Does not terminate or cycles on defrost	Defrost thermostats (DTT) shorted closed Head pressure control switch (HP-2) defective Low refrigerant charge Defrost air switch (DA) out of adjustment	4.19 4.15 4.9 4.19 & 4.20
3.3.6 Abnormal Pressure **3.3.6.1 Cooling**		
High discharge pressure	Quench valve malfunction Condenser coil dirty Condenser fan defective V-belt broken or loose Discharge check valve restricted Noncondensibles or refrigerant overcharge Solenoid valve (SV-1) malfunction	Replace 4.23 4.21 4.4 4.13 Replace 4.18
Low discharge pressure	Compressor valves(s) worn or broken	4.10
High suction pressure	Compressor valves(s) worn or broken Compressor gasket(s) defective	4.10 4.10
Low suction pressure	Suction service valve partially closed King valve partially closed Filter-drier partially plugged Low refrigerant charge Expansion valve malfunction No evaporator air flow or restricted air flow Excessive frost on coil Solenoid valve (SV-2) defective	Open Open 4.14 4.9 3.3.10 3.3.9 4.19 4.17
Suction and discharge pressures tend to equalize when unit is operating	Compressor valves defective	4.10

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.6.2 Heating		
High discharge pressure	Solenoid valves (SV-1, SV-3 and SV-4) malfunction Condenser fan defective V-belts broken or loose Noncondensibles in system Head pressure control switch (HP-2) defective (closed)	3.3.11 4.21 4.4 Check 4.15
Low discharge pressure	Compressor valve(s) worn or broken Head pressure control switch (HP-2) defective(open) Solenoid valve (SV-1) malfunction Low refrigerant charge	4.10 4.15 3.3.11 4.9
Low suction pressure	Refrigerant shortage Solenoid (SV-1) open Defective HP-2	4.9 3.3.11 4.15
3.3.7 Abnormal Noise		
Compressor	Loose mounting bolts Worn bearings Worn or broken valves Liquid slugging Insufficient oil	Tighten 4.10 4.10 3.3.10 4.11
Condenser or evaporator fan	Loose or striking shroud Bearings defective Bent shaft	Check 4.21 4.21
Clutch/Gearbox	Defective	Replace
V-belts	Cracked or worn	4.4
3.3.8 Control System Malfunction		
Will not control	Sensor defective Relay(s) defective Microprocessor controller malfunction	4.29 Check 4.27
3.3.9 No Evaporator Air Flow or Restricted Air Flow		
Evaporator coil blocked	Frost on coil Dirty coil	4.19 4.22
No or partial evaporator air flow	V-belt broken or loose Clutch/Gearbox defective Evaporator fan loose or defective Evaporator fan rotating backwards Evaporator air flow blocked in trailer (box)	4.4 Replace 4.21 4.4 Check

INDICATION/ TROUBLE	POSSIBLE CAUSES	REFERENCE SECTION
3.3.10 Expansion Valve Malfunction		
Low suction pressure with high superheat	Low refrigerant charge External equalizer line plugged Ice formation at valve seat Wax, oil or dirt plugging valve or orifice Broken capillary Power assembly failure or partial Loss of element/bulb charge Superheat setting too high SV2 stuck closed	4.6/4.9 Clean 4.7 4.24 4.24 Replace Replace 4.24 3.3.11
Low superheat and liquid slugging in compressor	Superheat setting too low External equalizer line plugged Ice holding valve open Foreign material in valve Pin and seat of expansion valve eroded or held open by foreign material	4.24 Open 4.7 Clean 4.24
Fluctuating suction pressure	Improper bulb location or installation Low superheat setting	4.24 4.24
High superheat	Broken capillary	4.24
3.3.11 Solenoid Valve Malfunction		
Solenoid valve does not function properly	No power to valve Improper wiring or loose connections Coil defective Valve improperly assembled Coil or coil sleeve improperly assembled Movement of plunger restricted due to: a. Corroded or worn parts b. Foreign material lodged in valve c. Bent or dented enclosing tub	Check Check 4.17 4.17 4.17 4.17 4.17 4.17
Solenoid valve closes but refrigerant continues to flow	Foreign material lodged under seat Defective seat	Clean Replace
3.4 5 kw GENERATOR		
Electric heaters and fans do not function properly	5 kw generator malfunction	4.34

SECTION 4

SERVICE

WARNING

Beware of V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run-Stop switch is in the STOP position. Also disconnect the negative battery cable.

CAUTION

Unit with R404A and POE oil, the use of inert gas brazing procedures is mandatory; otherwise compressor failure will occur.

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws, U.S.A. EPA section 608.

4.1 MAINTENANCE SCHEDULE

UNIT ON	UNIT OFF	OPERATION	REFERENCE SECTION
a. Daily Maintenance			
	X	1. Pre-Trip Inspection – before starting	2.1.a
X		2. Pre-Trip Inspection – after starting	2.1.b
X		3. Check engine hours	Check
b. First 400 Hour Maintenance			
	X	1. Pre-Trip Inspection – before starting	2.1.a
	X	2. Change lube oil and filter	4.3.2
X		3. Pre-Trip Inspection – after starting	2.1.b
X		4. Check engine hours	Check
c. Every 1500 Hour Maintenance (Normal Operating Conditions)			
X	X	1. Complete 400 Hour Maintenance (Refer to paragraph 1.2 for oil change intervals)	4.1.b
	X	2. Tighten engine, compressor and unit mounting bolts	None
	X	3. Tighten all electrical connection in control box	Tighten
	X	4. Calibrate defrost air switch	4.20
	X	5. Replace air cleaner, check hose and connections	4.3.3
	X	6. Check water pump bearing end play	None
	X	7. Check alternator brushes	None
	X	8. Clean evaporator and condenser coils	4.22/4.23
	X	9. Check fuel pump (FP) filter	4.3.5
	X	10. Replace fuel filters	4.3.5
d. Every 3000 Hour Maintenance			
X	X	1. Complete a 1500 Hour Maintenance	4.1.c
	X	2. Clean crankcase breather	4.3.4
	X	3. Replace all V-belts	4.4
	X	4. Check starter condition	Engine Manual
	X	5. Check and adjust injector nozzles	Engine Manual
e. Every 6000 Hour or 2 Years Maintenance			
	X	1. Check and adjust injector nozzles	Engine Manual
	X	2. Check engine compression	Engine Manual
	X	3. Adjust engine valves	Engine Manual
X	X	4. Drain and flush cooling system	4.3.1

4.2 PRIMING THE FUEL SYSTEM

a. Mechanical Fuel Pump

The unit is equipped with a mechanical fuel lift pump, it is mounted on the engine next to the injection pump.(also see section 4.3.5) This pump has a manual plunger for bleeding fuel when the fuel tank has been run dry.

Since the unit employs a closed fuel circuit, it is recommended to use the following steps or remove fuel filter and fill with fuel and replace:

1. Turn bleed valve (Red) counter-clockwise until fully opened (See Figure 1-5).
2. Turn the top of the manual plunger counter-clockwise to unlock it. (See Figure 1-5) Then, slowly hand pump the manual plunger until a positive pressure (resistance) is felt, which will indicate fuel flow.
3. Depress and turn the top of the manual plunger clockwise to lock in place.
4. Start engine.
5. When engine is running properly, turn bleed valve clockwise until fully closed.

b. Electrical Fuel Pump

If the unit is equipped with electrical fuel pumps, they are mounted on the fuel tank mounting bracket.(also see section 4.3.5) It is recommended to use the following steps:

1. Open bleed valve located on top of the injection pump. (See Figure 1-5)
2. Start engine.
3. When engine is running properly, turn bleed valve clockwise until fully closed.

4.3 ENGINE SERVICE AND COMPONENTS

4.3.1 Cooling System

Air flows through the radiator by using the engine fan.

The radiator, externally and internally, must be clean for adequate cooling. The water pump V-belt must be adjusted periodically to provide maximum air flow. (Refer to section 4.4.2)

Do the following to service the cooling system:

CAUTION

Use only ethylene glycol anti-freeze (with inhibitors) in system as glycol by itself will damage the cooling system.
Always add pre-mixed 50/50 anti-freeze and water to radiator/engine. Never exceed more than a 50% concentration of anti-freeze. Use a low silicate anti-freeze meeting GM specifications GM 6038M or equal.

a. Remove all foreign material from the radiator coil by reversing the normal air flow. (Air is pulled in through the front and discharges over the engine.) Compressed air or water may be used as a cleaning agent. It may be necessary to use warm water mixed with any good commercial dishwasher detergent. Rinse coil with fresh water if a detergent is used.

b. Drain coolant completely by removing lower radiator hose and radiator cap.

c. Install hose and fill system with clean, untreated water to which three to five percent of an akalined based radiator cleaner should be added (six ounces – dry 151 grams to one gallon = 3.78 liters) of water.

d. Run engine 6 to 12 hours and drain system while warm. Rinse system three times after it has cooled down. Refill system with water.

e. Run engine to operating temperature. Drain system again and fill with treated water/anti-freeze. (see Caution Note and refer to section 1.2) NEVER POUR COLD WATER INTO A HOT ENGINE, however hot water can always be added to a cold engine.

4.3.2 Lube Oil Filters

After warming up the engine, stop engine, remove drain plug from oil reservoir and drain engine lube oil. Lightly oil gasket on filter before installing.

CAUTION

When changing oil filters, the new filters should be primed with clean oil. if the filters are not primed, the engine may operate for a period with no oil supplied to the bearings.

Replace filter(s) and add lube oil. (Refer to section 1.2) Warm up engine and check for leaks.

4.3.3 Engine Air Cleaner

a. Inspection

The dry type or oil bath air cleaner should be inspected regularly for leaks. A damaged air cleaner or hose can seriously affect the performance and life of the engine. The air cleaner is designed to effectively remove contaminants from the air stream entering the engine. An excessive accumulation of these contaminants in the air cleaner will impair its operation, therefore, a service schedule must be set up and followed. Remember that the air cleaner cleans the air, but the air cleaner requires cleaning. The following simple service steps are easily made while the engine is being serviced in the field.

The simple inspection steps are as follows:

1. Check all connections for mechanical tightness. Be sure cleaner outlet pipe is not fractured.
2. In case of leakage and if adjustment does not correct the trouble, replace necessary parts or gaskets. *Swelled or distorted gaskets must always be replaced.*

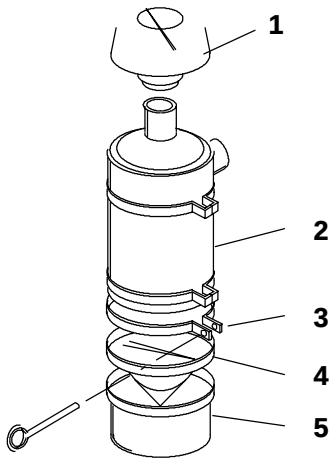
b. Air Cleaner Service Indicator

The air cleaner indicator is connected to the engine air intake manifold and its function is to indicate when the air cleaner requires replacing. In operation: When a plugged air cleaner decreases intake manifold pressure to 20" (500 mm) WG, the indicator moves to the red line. The air cleaner should be replaced and the indicator reset by pressing the reset button.

c. Service Procedure (Dry Type)

1. Stop the engine, remove air cleaner. Install new air cleaner.

d. Service Procedure (Oil Type)



1. Air Inlet Hood
2. Air Cleaner Body
3. Clamp
4. Inner Cup(Oil bath)
5. Oil or Dust Cup

Figure 4-1 Air Filter

CAUTION
Always cover the engine inlet tube while the air cleaner is being serviced.

1. Oil Cups

When to Service:

Remove the oil cup at regular intervals. Initially inspect daily or as often as conditions require. Never allow more than 1/2 inch (12.7 mm) of dirt deposit in either cup. More than 1/2 inch accumulation could result in oil and dirt to carry over into the engine causing accelerated engine wear. Heavily contaminated oil will not allow the air cleaner to function properly.

How to Service:

Stop the engine and remove the oil cup from the air cleaner. Dump the oil from the oil cups. Remove the inner cup from the oil cup and clean both cups of sludge.

Reassemble and fill both oil cups to the *indicated level* with SAE #10 oil for temperatures below freezing or SAE #30 for temperatures above freezing. It is generally a recommended practice to use the same oil as required in the engine crankcase. (Refer to section 1.2)

CAUTION
Do not underfill or overfill the cups. Overfilling of cups means loss of capacity and underfilling means lack of efficiency.

2. Body Assembly

When to Service:

The lower portion of the fixed element should be inspected each time the oil cup is inspected or serviced. If there is any sign of contaminant buildup or plugging, the body assembly should be removed and back flushed. At least one a year or at regular engine service periods remove the entire air cleaner and perform the following:

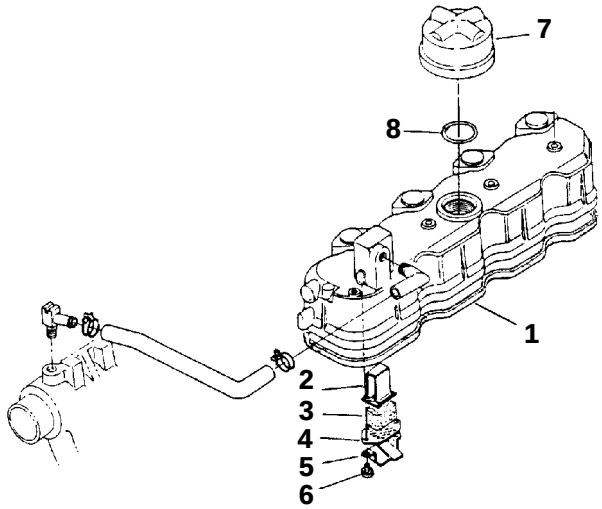
(a) Remove oil cup. Check and clean center tube. *DO NOT USE GASOLINE.*

(b) Pump solvent through the air outlet with sufficient force and volume to produce a hard, even stream out the bottom of the body assembly. Reverse flush until all foreign material is removed.

4.3.4 Engine Crankcase Breather

The engine uses a closed type breather with the breather line attached to the cylinder head cover. (See Figure 4-2)

The breather assembly should be cleaned once a year or at every 3000 hours maintenance interval (whichever comes first).



1. Cylinder Head Cover
2. Breather Cover
3. Breather Element
4. Plate
5. Breather Oil Shield
6. Bolt
7. Breather Assembly
8. O-Ring

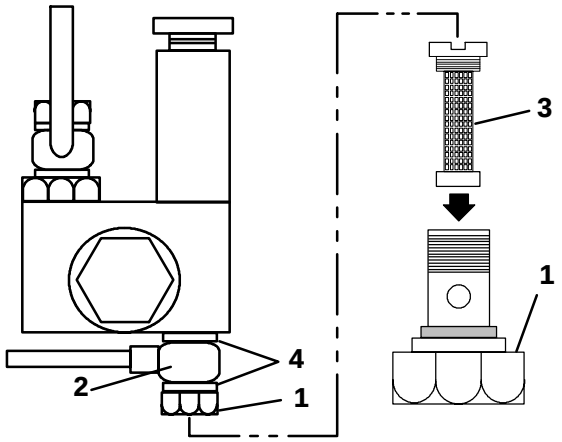
Figure 4-2. Engine Crankcase Breather

4.3.5 Servicing Fuel Pump

a. Mechanical Pump (See Figure 4-3)

Due to foreign particles in the fuel and wax as a result of using the wrong grade of fuel or untreated fuel in cold weather. The fuel filter may become plugged or restricted, and the engine will loose capacity. The filter must be cleaned on a regular schedule such as unit pre-trip or when the oil and fuel filters are changed (Refer to section 4.1).

1. Turn nut counter-clockwise to loosen and remove (item 1, Figure 4-3).
2. Remove banjo fitting (item 2) and let it hang loose, making sure to keep copper rings (item 4) for replacement.
3. Turn filter (item 3) counter-clockwise and remove. Check and clean.
4. To install reverse steps 1 through 3.



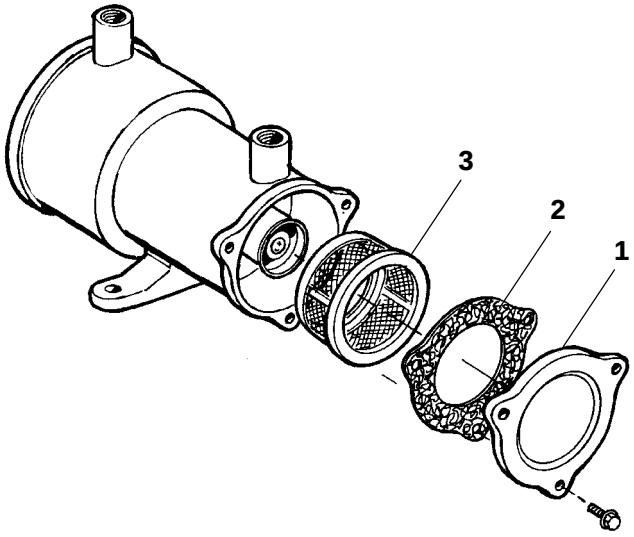
1. Nut
2. Banjo
3. Filter
4. Copper Rings

Figure 4-3. Mechanical Fuel Pump

b. Electrical Pump (See Figure 4-4)

To Check or Replace Filter

1. Remove 3 screws from cover (item 1, Figure 4-4).
2. Remove cover, gasket and filter.
3. Wash filter in cleaning solvent and blow out with air pressure. Clean cover.
4. To Install reverse above steps.



1. Cover
2. Gasket
3. Filter

Figure 4-4. Electric Fuel Pump (Optional)

4.3.6 Servicing Glow Plugs

The glow plugs, when energized, draw a nominal 7.0 amps at 10.5 vdc. When servicing, the glow plug is to be fitted carefully into the cylinder head to prevent damage to glow plug. Torque value for the glow plug is 14 to 18 ft-lb (1.9 to 2.5 mkg).

Checking for a Defective Glow Plug

a. One method is to place an ammeter (or clip-on ammeter) in series with each glow plug and energize the plugs. Each plug (if good) should show 7 to 10 amps draw.

b. A second method is to disconnect the wire connection to the plug and test the resistance from the plug to a ground on the engine block. The reading should be 0.7 to 1.2 ohms if the plug is good.

4.4 SERVICING AND ADJUSTING V-BELTS

WARNING

Beware of V-belts and belt driven components as the unit may start automatically.

4.4.1 Belt Tension Gauge

It is recommended using a belt tension gauge (tester) P/N 07-00253, shown in Figure 4-5 whenever V-belts are adjusted or replaced.

A belt tension gauge provides an accurate and easy method of adjusting belts to their proper tension. Properly adjusted belts give long lasting and efficient service. Too much tension SHORTENS belt and bearing life, and too little tension causes slippage and excessive belt wear. It is also important to keep belts and sheaves free of any foreign material which may cause the belts to slip.

The belt tension gauge can be used to adjust all belts. The readings which we specify for Carrier Transicold units are applicable only for our belts and application, as the tension is dependent on the size of the belt and distance between sheaves. When using this gauge, it should be placed as close as possible to the midpoint between two sheaves. (See Figure 4-6)

The V-belts must be kept in good condition with the proper tension to provide adequate air movement across the coils.

Table 4-1. Belt Tension (See Figure 4-5)

BELTS	Tension
Water pump to Crankshaft	35 to 45
Clutch/Gearbox to Fan shaft	80 to 90
Clutch/Gearbox to Drivershaft	70 to 80
Clutch/Gearbox to Alternator	80 to 90
5kw Generator to Drivershaft	70 to 80

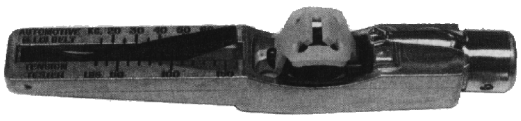


Figure 4-5 Belt Tension Gauge (Part No. 07-00253)

4.4.2 Water Pump V-Belt

The water pump V-belt is driven by a sheave on the engine crankshaft. Frayed, cracked or worn belts must be replaced. Adjustment is achieved by altering the position of the front side idler.

When replacing V-belt, avoid excessive force when applying tension to the V-belt to prevent damage to the water pump bearings. (Refer to Table 4-1)

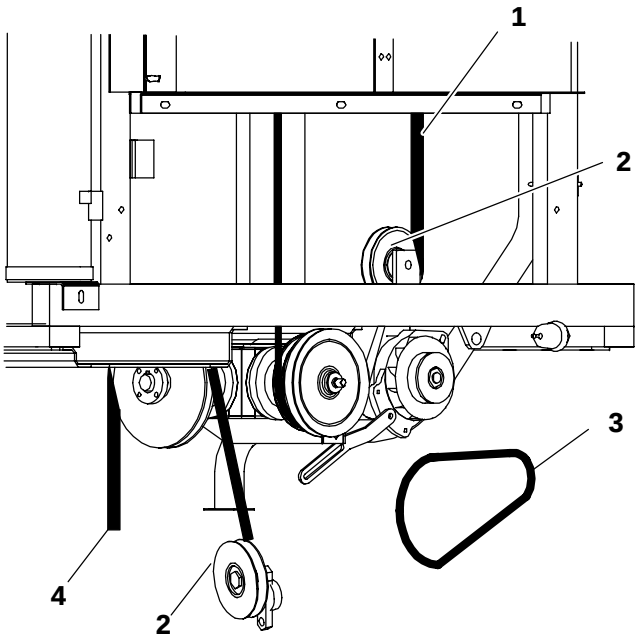
4.4.3 Alternator V-Belt

a. Make sure negative battery terminal is disconnected and remove old belt.

b. Place V-belt on alternator sheave and then install alternator with two bolts loosely in position.

c. Check the center alignment of the Clutch/Gearbox driving pulley and alternator pulley, to ensure proper drive. Pulley misalignment will create excess belt wear and limit alternator bearing life. The center line of the alternator sheave, and the driving sheave must be in line.

d. Pivot alternator to place tension on belt using hand force only. *Do not use pry bar or excessive force as it may cause bearing failure.* For correct belt tension see table 4-1. Tighten pivot and adjustment bolts.



1. Evaporator/Condenser Fan V-Belt
2. Idler Pulley
3. Alternator V-Belt
4. Drive V-Belt

Figure 4-6. V-Belt Arrangement

4.4.4 Driveshaft to Clutch/Gearbox and Clutch/Gearbox To Evaporator/Condenser Fans

a. Clutch/Gearbox to Fan Shaft V-Belt

To Replace V-belt:

1. Disconnect negative battery cable and remove V-belt guard.
2. Loosen idler pulley.
3. Remove old belt and replace with new belt. (See Figure 4-6)
4. Using a belt tension gauge (Figure 4-5) on the belt, rotate idler pulley so that the gauge reads the correct tension (Refer to Table 4-1).
5. Tighten idler, carriage bolt, and bolts.

NOTE

Both belts must be checked and retensioned, if necessary, after a brief run-in period. (see step 6)

6. Operate unit in high speed for 5 to 10 minutes. Repeat steps 4 and 5.
7. Replace belt guard.

b. Driveshaft to Clutch/Gearbox

1. Disconnect negative battery cable and remove V-belt guard and then loosen idler bolt.
2. Match mark adapter to engine flywheel (See Figure 4-7A) for ease of assembly.
3. Remove six bolts (5/16-18 x 1 lg) securing adapter drive sheave to engine flywheel, Figure 4-7A.
4. Insert 2 of the six bolts (5/16-18 x 1 lg) into the threaded holes (jacking holes) provided on engine adapter. Jack adapter from engine flywheel. Remove the 2 screws from adapter. Insert a pry bar between engine flywheel and adapter, Figure 4-7A and slide the adapter-sheave toward the compressor enough to change the V-belt as shown in Figure 4-7B. Replace V-belt.
5. Pry the adapter back toward the engine flywheel or use 5/16-18 x 2-1/2 lg bolts (3) in every other hole of adapter and take up evenly on the bolts until the 5/16-18 x 1 lg bolts will start in the engine flywheel. Apply thread sealer (Loctite #262) to the bolts used to secure adapter to flywheel. Take up on all bolts evenly and then torque to a value of 28 ft-lb (3.87 mkg).
6. Place V-belt on the Clutch/Gearbox sheave and adjust belt tension as indicated in Table 4-1. Install V-belt guard. DO NOT START UNIT UNTIL V-BELT GUARD IS INSTALLED.
7. Start unit and run for 10 minutes to allow for belt stretch.
8. Turn unit off and recheck belt tension.

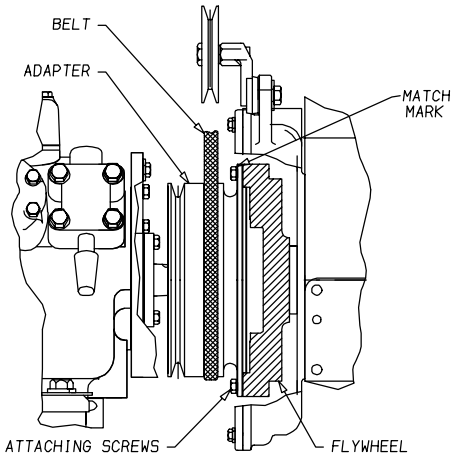


Figure A

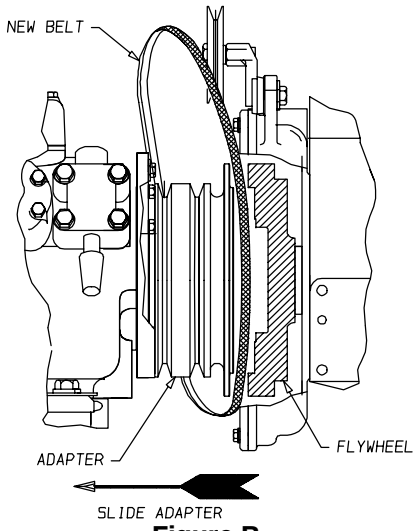


Figure B

Figure 4-7. Removing V-Belt from Engine Adapter Drive Sheave

4.5 PUMPING THE UNIT DOWN OR REMOVING THE REFRIGERANT CHARGE

NOTE

To avoid damage to the earth's ozone layer, use a refrigerant recovery system whenever removing refrigerant. When working with refrigerants you must comply with all local government environmental laws, U.S.A. EPA section 608.

a. Pumping the Unit Down

To service the filter-drier, liquid line solenoid valve (SV-2), expansion valve, quench valve or evaporator coil, pump most of refrigerant into condenser coil and receiver as follows:

1. Backseat suction and discharge service valve (turn counterclockwise) to close off gauge connection and attach manifold gauges to valves.
2. Open valves two turns (clockwise). Purge gauge line.
3. Close the receiver outlet (king) valve by turning clockwise. Start unit and run in high speed cooling. Place Run-stop switch in the STOP position when unit reaches 1 psig (0.1 kg/cm@).
4. Frontseat (close) suction service valve and the refrigerant will be trapped between the compressor suction service valve and the manual shutoff (King) valve.
5. Before opening up any part of the system, a slight positive pressure should be indicated on the pressure gauge.
6. When opening up the refrigerant system, certain parts may frost. Allow the part to warm to ambient temperature before dismantling. This avoids internal condensation which puts moisture in the system.
7. Open (backseat) King valve and midseat suction service valve.
8. Leak check connections with a leak detector. (Refer to section 4.6)
9. Start the unit in cooling and check for noncondensibles.
10. Check the refrigerant charge. (Refer to section 4.8.f)

NOTE

Store the refrigerant charge in an evacuated container if the system must be opened between the compressor discharge valve and receiver.

Whenever the system is opened, it must be evacuated and dehydrated. (Refer to section 4.7)

b. Removing the Refrigerant Charge

Connect a refrigerant recovery system to the unit to remove refrigerant charge. Refer to instruction provided by the manufacture of the refrigerant recovery system.

4.6 REFRIGERANT LEAK CHECKING

a. If system was opened and repairs completed, leak check the unit.

b. The recommended procedure for finding leaks in a system is with a halide torch or electronic leak detector. Testing joints with soapsuds is satisfactory only for locating large leaks.

c. If system is without refrigerant, charge system with refrigerant to build up pressure between 30 to 50 psig (2.1 to 3.5 kg/cm@). Remove refrigerant drum and leak check all connections.

NOTE

It must be emphasized that only the correct refrigerant drum be connected to pressurize the system. Any other gas or vapor will contaminate the system which will require additional purging and evacuation of the high side (discharge) of the system.

d. Remove refrigerant using a refrigerant recovery system and repair any leaks. Evacuate and dehydrate the unit. (Refer to section 4.7) Charge unit with refrigerant. (Refer to section 4.8)

4.7 EVACUATION AND DEHYDRATION

4.7.1 General

Moisture is the deadly enemy of refrigerant systems. The presence of moisture in a refrigeration system can have many undesirable effects. The most common are copper plating, acid sludge formation, “freezing-up” of metering devices by free water, and formation of acids, resulting in metal corrosion.

4.7.2 Preparation

a. Evacuate and dehydrate only after pressure leak test. (Refer to section 4.6)

b. Essential tools to properly evacuate and dehydrate any system include a good vacuum pump (5 cfm = 8m#H volume displacement, P/N 07-00176-01) and a good vacuum indicator such as a thermocouple vacuum gauge (vacuum indicator). (Available through Robinair Manufacturing, Montpelier, Ohio, Part Number 14010.)

NOTE

It is not recommended using a compound gauge because of its inherent inaccuracy.

c. Keep the ambient temperature above 60_F (15.6_C) to speed evaporation of moisture. If ambient temperature is lower than 60_F (15.6_C), ice might form before moisture removal is complete. Heat lamps or alternate sources of heat may be used to raise system temperature.

4.7.3 Procedure for Evacuation and Dehydrating System

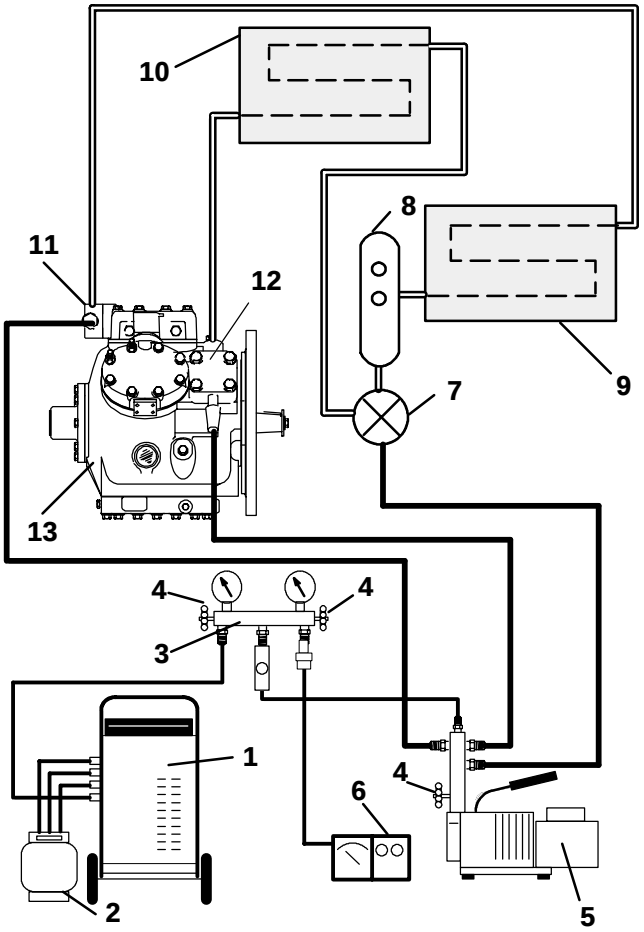
a. Remove refrigerant using a refrigerant recovery system.

b. The recommended method to evacuate and dehydrate the system is to connect three evacuation hoses (Do not use standard service hoses, as they are not suited for evacuation purposes.) as shown in Figure 4-8 to the vacuum pump and refrigeration unit. Also, as shown, connect a evacuation manifold, with evacuation hoses only, to the vacuum pump, electronic vacuum gauge, and refrigerant recovery system.

c. With the unit service valves closed (back seated) and the vacuum pump and electronic vacuum gauge valves open, start the pump and draw a deep vacuum. Shut off the pump and check to see if the vacuum holds. This operation is to test the evacuation setup for leaks, repair if necessary.

d. Midseat the refrigerant system service valves.

e. Then open the vacuum pump and electronic vacuum gauge valves, if they are not already open. Start the vacuum pump. Evacuate unit until the electronic vacuum gauge indicates 2000 microns. Close the electronic vacuum gauge and vacuum pump valves. Shut off the vacuum pump. Wait a few minutes to be sure the vacuum holds.



1. Refrigerant Recovery Unit
2. Refrigerant Cylinder
3. Evacuation Manifold
4. Valve
5. Vacuum Pump
6. Vacuum Gauge
7. King Valve
8. Receiver
9. Condenser
10. Evaporator
11. Discharge Valve
12. Suction Valve
13. Compressor

Figure 4-8. Vacuum Pump Connection

f. Break the vacuum with clean dry refrigerant. Use refrigerant that the unit calls for. Raise system pressure to approximately 2 psig.

g. Remove refrigerant using a refrigerant recovery system.

h. Repeat steps e through g one time.

i. Evacuate unit to 500 microns. Close off vacuum pump valve and stop pump. Wait five minutes to see if vacuum holds. This checks for residual moisture and/or leaks.

j. With a vacuum still in the unit, the refrigerant charge may be drawn into the system from a refrigerant container on weight scales. The correct amount of refrigerant may be added by observing the scales. (Refer to section 4.8)

4.8 ADDING REFRIGERANT TO SYSTEM (FULL CHARGE)

a. Dehydrate unit and leave in deep vacuum. (Refer to section 4.7)

b. Place drum of refrigerant on scale and connect charging line from drum to king valve.

c. Note weight of drum and refrigerant.

d. Open liquid valve on drum. Open king valve half way and allow the liquid refrigerant to flow into the unit until the correct weight of refrigerant has been added as indicated by scales. Correct charge will be found in section 1.3.

NOTE

It is possible that all liquid may not be pulled into the receiver, as outlined in step d. In this case, frontseat the receiver outlet valve (king valve) and the liquid will be pulled into the system. Unit must be operating in the cooling mode.

e. When drum weight (scale) indicates that the correct charge has been added, close liquid line valve on drum and backseat the king valve.

f. Start unit in cooling mode. Run approximately ten minutes. Partially block off air flow to condenser coil so discharge pressure rises to 230 psig (16 kg/cm@).

Refrigerant should appear at center line of lower receiver sight glass. If charge is inadequate, add refrigerant charge (per section 4.9).

4.9 ADDING REFRIGERANT TO SYSTEM (PARTIAL CHARGE) -- R-22 ONLY

CAUTION

Do not vapor charge R-404A. Only liquid charging through the liquid line king valve is acceptable.

a. Place drum of refrigerant on scale and note weight. Backseat suction service valve and connect charging line between suction valve port and drum. Open VAPOR valve on drum.

b. Run the host unit and the remote compartments in cooling for two minutes. This will fill the remote liquid line with refrigerant.

c. Turn OFF the remote compartments. Continue running the host in cooling.

d. Run the host unit in cooling for ten minutes and then partially block off air flow to condenser coil so discharge pressure will rise 10 psig (0.7 kg/cm@). Refrigerant should appear at center line of the lower receiver sight glass . If charge is inadequate, add refrigerant charge with condenser coil still blocked.

e. Open suction service valve three turns. Add charge until level appears at center line of the lower receiver sight glass.

f. Backseat (close) suction service valve. Close vapor valve on refrigerant drum, noting weight. Vent charging line and replace all caps.

g. Start unit and check for noncondensibles.

4.10 REPLACING THE COMPRESSOR

If compressor is inoperative and unit still has refrigerant pressure, frontseat suction and discharge service valves to trap most of the refrigerant in the unit.

If compressor runs, pump down the unit. (Refer to section 4.5.a)

a. Remove the two rear compressor bracket mounting bolts (compressor shockmount end).

b. Block up engine.

c. Slowly release compressor pressure to a recovery system.

d. Remove bolts from suction and discharge service valve flanges.

e. Remove oil filter and bracket from 05G compressor.

f. Disconnect wiring to unloader valve assemblies, compressor discharge temperature sensor (CDT), suction pressure transducer and the wiring to the high pressure cutout switches (HP-1 and HP-2). Identify wiring and switches if necessary. (See Figure 4-10)

g. Remove 10 bolts from the engine-compressor spacer.

h. Disconnect ground strap from frame.

i. Disconnect suction pressure transducer from compressor .

j. Attach sling or other device to the compressor.

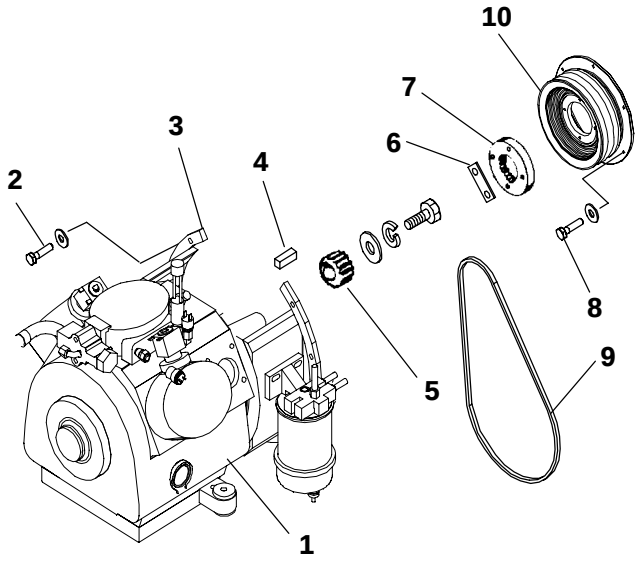
k. Slide compressor enough to clear nylon drive gear (or clutch housing on model NDM), Figure 4-9, and remove compressor from unit.

l. Drain oil from defective compressor before shipping.

m. The original unloader valves must be transferred to the replacement compressor. The plug arrangement removed from the replacement is installed in the original compressor as a seal. If piston is stuck, it may be extracted by threading socket head cap screw into top of piston. A small teflon seat ring at bottom of piston must be removed.

NOTES

The service replacement compressor is sold without shutoff valves (but with valve pads). Customer should retain the original capacity control valves for use on replacement compressor. Check oil level in service replacement compressor. (Refer to sections 1.3, and 4.11)



1. Compressor
2. Bolts
3. Spacer
4. Key
5. Compressor Drive Gear
6. Locking Tab
7. Nylon Drive Gear
8. Drive Sheave Bolts
9. V-Belt
10. Engine Adapter Drive Sheave

Figure 4-9. Compressor Drive Assembly

n. Remove the complete high pressure switch assembly (HP-1 and HP-2) (See Figure 4-10) and install on new compressor after checking switch settings. Remove compressor discharge temperature sensor (CDT) and suction pressure transducer and install on new compressor. Install compressor frame to new compressor (if removed with defective compressor).

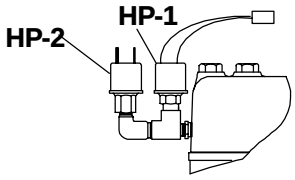


Figure 4-10. Pressure Switches HP-1 and HP-2

o. Install compressor in unit by reversing step 4.12.c through n. It is recommended using new locknuts when replacing compressor. Torque bolts to a value of 46 ft/lb (6.4 mkg). Install new gaskets on service valves and tighten bolts uniformly.

p. Attach two lines (with hand valves near vacuum pump) to the suction and discharge service valves. Dehydrate and evacuate compressor to 500 microns (29.90" Hg vacuum = 75.9 cm Hg vacuum). Turn off valves on both lines to pump.

q. Fully backseat (open) both suction and discharge service valves.

r. Remove vacuum pump lines and install manifold gauges.

s. Start unit and check for noncondensibles.

t. Check refrigerant level (section 4.9.b.)

u. Check compressor oil level. (Refer to section 4.11) Add oil if necessary.

v. Check compressor unloader operation. (Refer to section 4.12)

w. Check refrigerant cycles. (Refer to section 2)

4.11 CHECKING COMPRESSOR OIL LEVEL

a. To Check the Oil Level in the Compressor:

1. Operate the unit in high speed cooling for at least 20 minutes.
2. Check the oil sight glass on the compressor to ensure that no foaming of the oil is present after 20 minutes of operation. If the oil is foaming excessively after 20 minutes of operation, check the refrigerant system for flood-back of liquid refrigerant. Correct this situation before performing step 3.
3. Check the level of the oil in the sight glass with the compressor operating (See Figure 4-11).

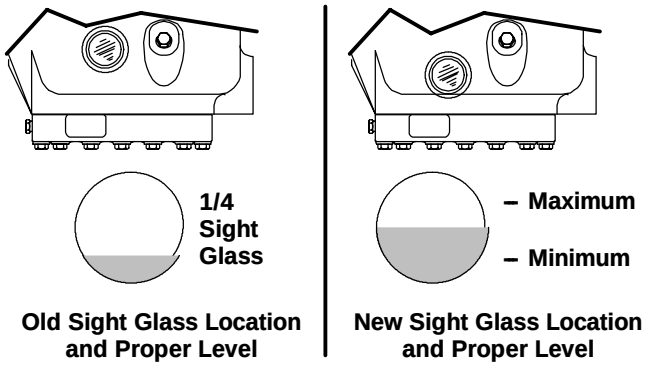


Figure 4-11. Oil Level in Sight Glass

b. Adding Oil with Compressor in System

Two methods for adding oil are the oil pump method and closed system method.

1. Oil Pump Method

One compressor oil pump that may be purchased is a Robinair, part no. 14388. This oil pump adapts to a one U.S. gallon (3.785 liters) metal refrigeration oil container and pumps 2-1/2 ounces (0.0725 liters) per stroke when connected to the oil fill (item4, Figure 4-12). Also there is no need to remove pump from can after each use.

When the compressor is in operation, the pump check valve prevents the loss of refrigerant, while allowing servicemen to develop sufficient pressure to overcome the operating suction pressure to add oil as necessary.

Backseat suction service valve and connect oil charging hose to oil fill (item4, Figure 4-12). Purge the oil hose at oil pump. Add oil as necessary (Refer to section 1.3).

2. Closed System Method

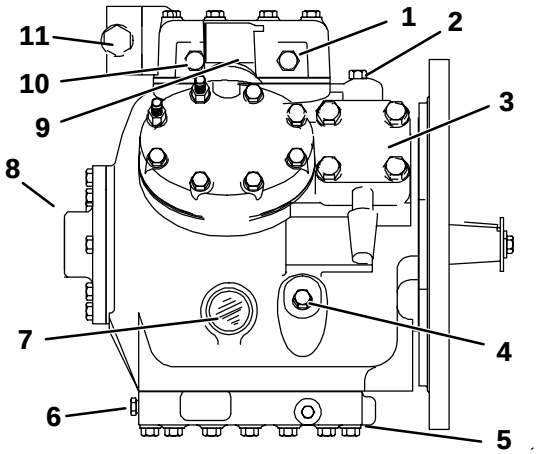
In an emergency where an oil pump is not available, oil may be drawn into the compressor through the suction service valve.

CAUTION

Extreme care must be taken to ensure the manifold common connection remains immersed in oil at all times. Otherwise air and moisture will be drawn into the compressor.

Connect the suction connection of the gauge manifold to the compressor suction service valve port, and immerse the common connection of the gauge manifold in an open container of refrigeration oil. Crack the suction service valve and gauge valve to vent a small amount of refrigerant through the common connection and the oil to purge the lines of air. Close the gauge manifold valve.

With the unit running, frontseat the suction service valve and pull a vacuum in the compressor crankcase. SLOWLY crack the suction gauge manifold valve and oil will flow through the suction service valve into the compressor. Add oil as necessary (Refer to section 1.3).



05G

1. High Pressure Switch Connection
2. Suction Pressure Transducer Connection
3. Suction Service Valve
4. Oil Fill Plug
5. Bottom Plate
6. Oil Drain Plug
7. Oil Level Sight Glass
8. Oil Pump
9. Unloader Solenoid
10. Discharge Thermistor Connection
11. Discharge Service Valve

Figure 4-12. Compressor

c. Adding Oil to Service Replacement Compressor

Service replacement compressors may or may not be shipped with oil.

If compressor is without oil:

Add correct oil charge (Refer to section 1.3) through the suction service valve flange cavity or by removing the oil fill plug (See Figure 4-12)

d. To remove oil from the compressor:

1. Close suction service valve (frontseat) and pump unit down to 2 to 4 psig (0.1 to 0.3 kg/cm@). Frontseat discharge service valve and slowly bleed remaining refrigerant.
2. Remove the oil drain plug from the compressor and drain the proper amount of oil. Replace the plug securely back into the compressor.
3. Open service valves and run unit to check oil level, repeat as required to ensure proper oil level.

4.12 COMPRESSOR UNLOADER VALVE

The compressor unloaders (located on the compressor cylinder heads) are controlled by relays UFR,URR and the temperature controller. (Refer to section 1.10)

a. Checkout Procedure

1. Connect manifold gauges to the compressor suction and discharge service valves and start unit in cooling with the trailer temperature at least 5_F (2.8_C) above set point and the compressor will be fully loaded (both unloader coils are de-energized). Note suction pressure.
2. Remove wiring from the front unloader coil. Place electrical tape over wire terminals.
3. Set controller upscale (cooler to warmer). This mechanically simulates falling temperature. Approximately 2_F (1.1_C) below box temperature the unloader coils will energize, but only the rear unloader valve will unload. Note suction pressure, a rise of approximately 3 psig (0.2 kg/cm@) will be noted on the suction pressure gauge.
4. Reconnect wiring on the front unloader. The front unloader will retract and an additional 3 psig (0.2 kg/cm@) rise on the suction gauge will be noted. Compressor is now fully unloaded and only the top bank is loaded (two cylinders).
5. Reverse the above procedure to check out compressor loading. Suction pressure will drop with this test.

NOTE

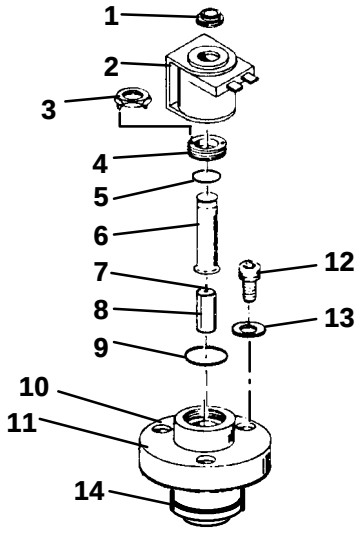
If either unloader coil energizes and the suction pressure does not change, the unloader assembly must be checked.

b. Solenoid Coil Replacement

NOTE

The coil may be removed without pumping the unit down.

1. Disconnect leads. Remove retainer. Lift off coil. (See Figure 4-13)
2. Verify coil type, voltage and frequency of old and new coil. This information appears on the coil housing.
3. Place new coil over enclosing tube, retainer and connect wiring.



1. Retainer
2. Coil Assembly
3. Installation/Removal Tool
4. Enclosing Tube Collar
5. "O" Ring
6. Enclosing Tube
7. Plunger Spring
8. Plunger Assembly
9. Gasket
10. Valve Body
11. Gasket
12. Bolt
13. Gasket, Bolt
14. Piston Ring

Figure 4-13. Unloader Solenoid Valve

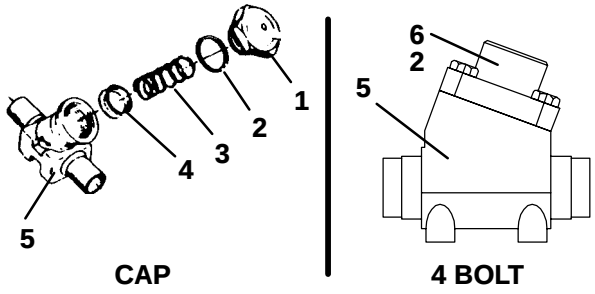
c. Replacing Solenoid Valve Internal Parts (See Figure 4-13)

1. Pump down the unit. Frontseat both service valves to isolate the compressor.
2. Remove coil retainer, and coil.
3. Remove enclosing tube collar (item 4, Figure 4-13) using installation/removal tool supplied with repair kit (item 3).
4. Check plunger for restriction due to: (a) Corroded or worn parts; (b) Foreign material lodged in valve; (c) Bent or dented enclosing tube.
5. Install new parts. Do not overtighten enclosing tube assembly. Torque to a value of 100 inch pounds (1.15 mkg).
6. Remove supplied installation/removal tool. Install coil, voltage plate, and retainer.
7. Evacuate and dehydrate the compressor. (Refer to section 4.10.p through 4.10.w.)
8. Start unit and check unloader operation (Refer to section 4.12.a).

4.13 SERVICING THE CHECK VALVE -- SERVICEABLE TYPE

The check valve allows the hot gas to travel in one direction only.

The function of the condenser coil bypass is to raise the receiver pressure when the ambient temperature is low so that refrigerant can flow from the receiver to the evaporator when the unit is in heating or defrost.



1. Cap
2. Copper Washer
3. Spring
4. Brass/Teflon Seat
5. Body
6. Cover

Figure 4-14. Check Valve -- Serviceable Type

a. To replace check valve, store the refrigerant into an evacuated container. (Refer to section 4.5)

b. Replace necessary parts.

c. Evacuate and dehydrate unit. (Refer to section 4.7)

d. Add refrigerant charge. (Refer to section 4.8)

4.14 CHECKING AND REPLACING FILTER-DRIER

To Check Filter-Drier

Check for a restricted or plugged filter-drier by feeling the liquid line inlet and outlet connections of the drier cartridge. If the outlet side feels cooler than the inlet side, then the filter-drier should be changed.

To Replace Filter-Drier

a. Pump down the unit per section 4.5. Remove bracket, then replace drier.

b. Check refrigerant level. (Refer to section 4.9.b)

4.15 CHECKING AND REPLACING HIGH PRESSURE CUTOUT SWITCH

4.15.1 Replacing High Pressure Switch

a. Pump down the unit. (Refer to section 4.5.a) Frontseat both suction and discharge service valves to isolate compressor.

b. *Slowly* release compressor pressure through the service valve gauge ports.

c. Disconnect wiring from defective switch. The high pressure switches are located on the top cylinder head. (See Figure 4-12)

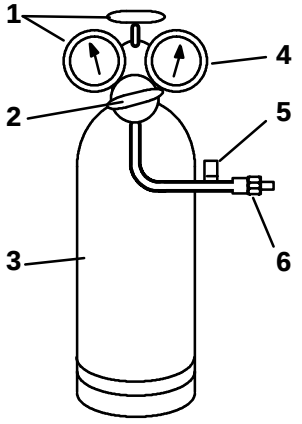
d. Install new cutout switch after verifying switch settings. (Refer to section 4.15.2)

e. Evacuate and dehydrate the compressor. (Refer to section 4.10.p through 4.10.w**)**

4.15.2 Checking High Pressure Switch (HP-1 or HP-2)

WARNING

Do not use a nitrogen cylinder without a pressure regulator. Cylinder pressure is approximately 2350 psi (165 kg/cm@). Do not use oxygen in or near a refrigerant system as an explosion may occur. (See Figure 4-15)



1. Cylinder Valve and Gauge
2. Pressure Regulator
3. Nitrogen Cylinder
4. Pressure Gauge (0 to 400 psig = 0 to 28 kg/cm@)
5. Bleed-Off Valve
6. 1/4 inch Connection

Figure 4-15. Typical Setup for Testing High Pressure Switch

a. Remove switch as outlined in section 4.15.1.

b. Connect ohmmeter or continuity light across switch terminals. Ohmmeter will indicate resistance and continuity light will be lighted if switch closed after relieving pressure.

c. Connect switch to a cylinder of dry nitrogen. (See Figure 4-15)

d. Set nitrogen pressure regulator higher than cutout point on switch being tested. Pressure switch cutout and cut-in points are shown in sections 1.3.

e. Close valve on cylinder and open bleed-off valve.

f. Open cylinder valve. Slowly close bleed-off valve and increase pressure until the switch opens. If light is used, light will go out and if an ohmmeter is used, the meter will indicate open. Open pressure on gauge. Slowly open bleed-off valve (to decrease pressure) until switch closes (light will light or ohmmeter will move).

4.16 REPLACING RECEIVER SIGHT GLASS ASSEMBLY

NOTE

There are two types of receiver sight glasses. One is the floating ball type (P/N 14-00111), and the second is the prism type (P/N 14-50023-00); both are interchangeable.

a. Store the refrigerant in an evacuated container. (Refer to section 4.5.b)

b. Unscrew the sight glass assembly. Spread some sealing compound on pipe threads of new sight glass assembly and install.

c. Leak check receiver sight glass per section 4.6.

d. After leak checking unit, evacuate and dehydrate as outlined in section 4.7.

e. Add refrigerant charge. (Refer to section 4.8)

f. Check for noncondensibles.

4.17 SERVICING SOLENOID VALVES

4.17.1 Solenoid Valves -- Alco SV2/SV3/SV4

CAUTION

Do not damage or overtighten the enclosing tube assembly. Torque to 200-inch pounds (2.3 mkg). Also make sure all parts are placed on the enclosing tube in proper sequence to avoid premature coil burnout.

a. Replacing the Coil

NOTE

The coil may be replaced without removing the refrigerant or pumping the unit down.

1. Disconnect leads, remove coil retainer and coil assembly.
2. Verify coil type, voltage and frequency. This information appears on the coil housing.
3. Place new coil over enclosing tube, retainer and connect wiring.

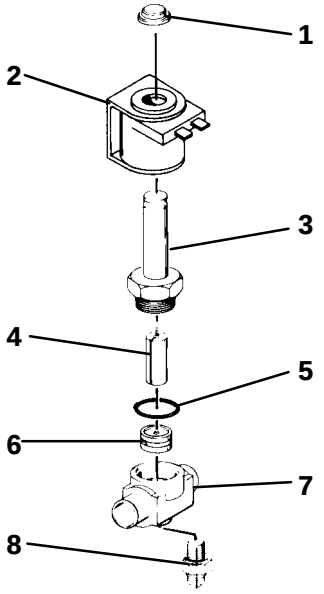
b. Replacing Solenoid Valve Internal Parts (See Figure 4-16)

The liquid line solenoid valve (SV2) may be serviced by pumping the unit down. (Refer to section 4.5.a)

Remove and store the refrigerant charge in an evacuated container to service hot gas solenoid valve. (Refer to section 4.5.b)

1. Remove coil retainer and coil assembly from valve. Remove enclosing tube assembly and related items.
2. Check for foreign material in valve body.
3. Install new parts.
4. Tighten enclosing tube assembly to a torque value of 200 inch pounds (2.3 mkg) and leak check the valve. (Refer to section 4.6)
5. Install coil assembly and retainer.
6. Start unit and check refrigerant charge per section 4.8.f.

7. Check refrigeration cycles.(Refer to section 2)



1. Retainer
2. Coil Assembly
3. Enclosing Tube Assembly
4. Plunger Assembly
5. Gasket
6. Piston Assembly
7. Body
8. Bracket Adapter

Figure 4-16. Solenoid Valves -- Alco

4.17.2 Solenoid Valve -- Sporlan SV1

a. Replacing the Coil

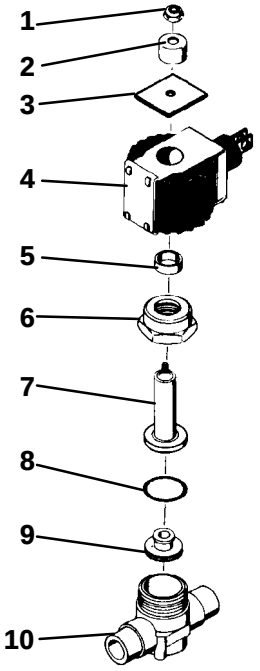
NOTE

The coil may be replaced without removing the refrigerant or pumping the unit down.

1. Remove top locknut, spacer cup and nameplate (SV1).
2. Disconnect wiring and remove coil.
3. Replace coil by reversing steps 1 and 2.

b. Replacing Internal Components (See Figure 4-17)

1. Remove and store the refrigerant charge in an evacuated container. (Refer to section 4.5.b)
2. Remove the top locknut, spacer cup, nameplate, coil assembly and spacer.
3. Using a 12 point, 1-3/8 inch box wrench, loosen the enclosing tube locknut and bleed off remaining refrigerant.
4. Remove enclosing tube and locknut assembly. The gasket is inside the enclosing tube.
5. Remove seat disc from inside of body and check for obstructions and foreign material.
6. Place the seat disc into the valve body with the smaller diameter end facing up.
7. Place the enclosing tube locknut over the enclosing tube. Install spacer over enclosing tube making sure it is seated properly in the enclosing tube locknut. Tighten enclosing tube locknut to a torque value of 20 ft-lb (2.78 mkg). Do not overtighten.



SV-1

1. Locknut/Screw
2. Spacer Cup
3. Nameplate
4. Coil
5. Spacer
6. Enclosing Tube Locknut
7. Enclosing Tube
8. Gasket
9. Seat Disc
10. Body

Figure 4-17. Solenoid Valves -- Sporlan

8. Install coil assembly, nameplate and top locknut or screw.
9. Dehydrate and evacuate the system. (Refer to section 4.7) Charge unit with refrigerant per sections 4.8 and 4.9.
10. Start unit and check operation. (Refer to section 2)

4.18 SOLENOID VALVE SV-1 CHECKOUT PROCEDURE

To obtain proper heating and defrost, the normally open (N.O.) SV-1 solenoid valve must energize and close tightly during the heat and defrost cycles. If the valve does not close tightly due to physical damage, foreign material or wear, refrigerant leakage through the valve can reduce heating capacity.

a. During normal heat or defrost cycles the following conditions will be observed when the valve is operating properly:

(1) Receiver refrigerant level will drop quickly at the initiation of heating or defrost mode.

(2) Suction pressure will rise slowly to 90–100 psig (6.3 to 7.0 kg/cm@).

(3) Discharge pressure will drop quickly, but begin to rise to a minimum of 250 psig (17.5 kg/cm@) within 15 to 20 minutes.

b. If suction and discharge pressures remain low and the receiver level does not drop, the valve may be inoperative and can be checked by the following method.

(1) Verify the solenoid coil has proper voltage and is energized in heating and defrosting.

(2) Connect a discharge pressure gauge to the compressor discharge service valve and connect a gauge to the liquid line valve (king valve) leaving the receiver tank.

(3) With the trailer temperature at 35_F (1.7_C) or lower, operate the unit in high speed cool and remove or disconnect the "hot" wire leading to the SV-1 coil.

(4) With a separate 12 vdc positive voltage, energize SV-1 with the unit in high speed cooling and observe the discharge and receiver pressures. If the valve is closing properly, compressor discharge pressure will begin to rise and the receiver pressure will remain the same or begin to drop slowly. If the valve is not seating properly, both discharge and receiver pressure will rise slowly or remain the same.

Operate the unit until discharge pressure reaches 200 psig (14 kg/cm@) and disconnect jumper wire to SV-1 valve. Discharge and receiver pressure should be within 5 to 15 psig (0.4 to 1.0 kg/cm@) of each other.

4.19 CHECKING DEFROST OR HEATING CYCLE

NOTE

The evaporator temperature must be 35_F (1.7_C) (approximately 40_F = 4.4_C box temperature) or lower, before any checks can be made.

a. Hot Gas Solenoid Valve (SV-1,SV-3 & SV-4) Heating and Defrosting

1. Connect a discharge pressure gauge to the King valve and another gauge to the compressor discharge service valve. Connect a gauge to the compressor suction service valve.
2. Start unit with controller set at least 10_F = 5.5_C below indicated box temperature to obtain high speed cooling. Press the MANUAL DEFROST key to initiate defrost. (Box temperature must be below 40_F = 4.4_C.) The hot gas solenoid valve (SV4) will energize and the hot gas line will be hot to touch on either side of the valve. The condenser pressure control solenoid (SV1) closes and suction pressure will rise approximately 10 to 15 psig (0.70 to 1.05 kg/cm@) after 5 minutes on unit operation. Refer to section 4.18 if unit does not heat properly.
3. SV-3 will open after a 60 second delay, if the engine is in high speed and the difference between ambient and discharge temperatures exceeds 100_F (55.6_C).If the difference between ambient and discharge temperatures goes below 50_F (27.8_C) SV-3 will close. The unit will remain in defrost until coil temperature increases to 50_F (10_C) where the defrost thermostats open and the unit resumes automatic operation.

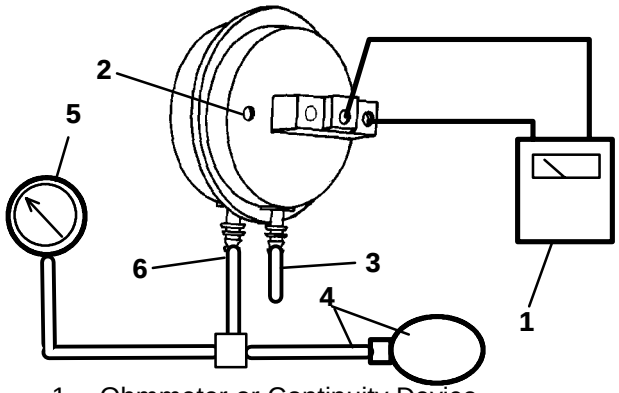
b. Defrost Air Switch (DA)

1. To check air switch, run unit in high speed cooling and jump across the air switch terminals. This will start the defrost cycle as it simulates the action of the defrost air switch. Bypassing the switch in this manner operates all components involved in defrost.
2. Unit should remain in defrost until evaporator coil temperature reaches 50_F (10_C). At this point the two defrost thermostats should open to terminate the defrost cycle. Replace the defrost thermostats if unit fails to terminate defrost.
3. If the above test indicates satisfactory operation, test defrost air switch (DA) settings using a Dwyer Magnehelic gauge (P/N 07-00177) or similar instrument. (Refer to section 4.20)

c. Solid State Defrost Timer

Refer to section 1.11.10 for description.

4.20 CHECKING CALIBRATION OF THE DEFROST AIR SWITCH



1. Ohmmeter or Continuity Device
2. Adjustment Screw (0.050 socket head size)
3. Low Side Connection
4. Pressure Line or Aspirator Bulb (P/N 07-00177-01)
5. Magnehelic Gauge (P/N 07-00177)
6. High Side Connection

Figure 4-18. Defrost Air Switch Test Setup

a. Make sure magnehelic gauge is in proper calibration.

NOTE

The magnehelic gauge may be used in any position, but must be re-zeroed if position of gauge is changed from vertical to horizontal or vice versa. USE ONLY IN POSITION FOR WHICH IT IS CALIBRATED.

b. With air switch in vertical position, connect high pressure side of magnehelic gauge to high side connection of air switch. (See Figure 4-18)

c. Install tee in pressure line to high side connection. Tee should be approximately half-way between

gauge and air switch or an improper reading may result.

d. Attach an ohmmeter to the air switch electrical contacts to check switch action.

NOTE

Use a hand aspirator (P/N 07-00177-01), since blowing into tube by mouth may cause an incorrect reading.

e. With the gauge reading at zero, apply air pressure very slowly to the air switch. An ohmmeter will indicate continuity when switch actuates.

f. Refer to section 1.3 for switch settings. If switch fails to actuate at correct gauge reading, adjust switch by turning adjusting screw clockwise to increase setting or counterclockwise to decrease setting.

g. Repeat checkout procedure until switch actuates at correct gauge reading.

h. After switch is adjusted, place a small amount of paint or glycerol on the adjusting screw so that vibration will not change switch setting.

4.21 REPLACING THE CONDENSER/ EVAPORATOR FAN SHAFT OR BEARING

WARNING

Beware of unannounced starting of the evaporator and condenser fan.

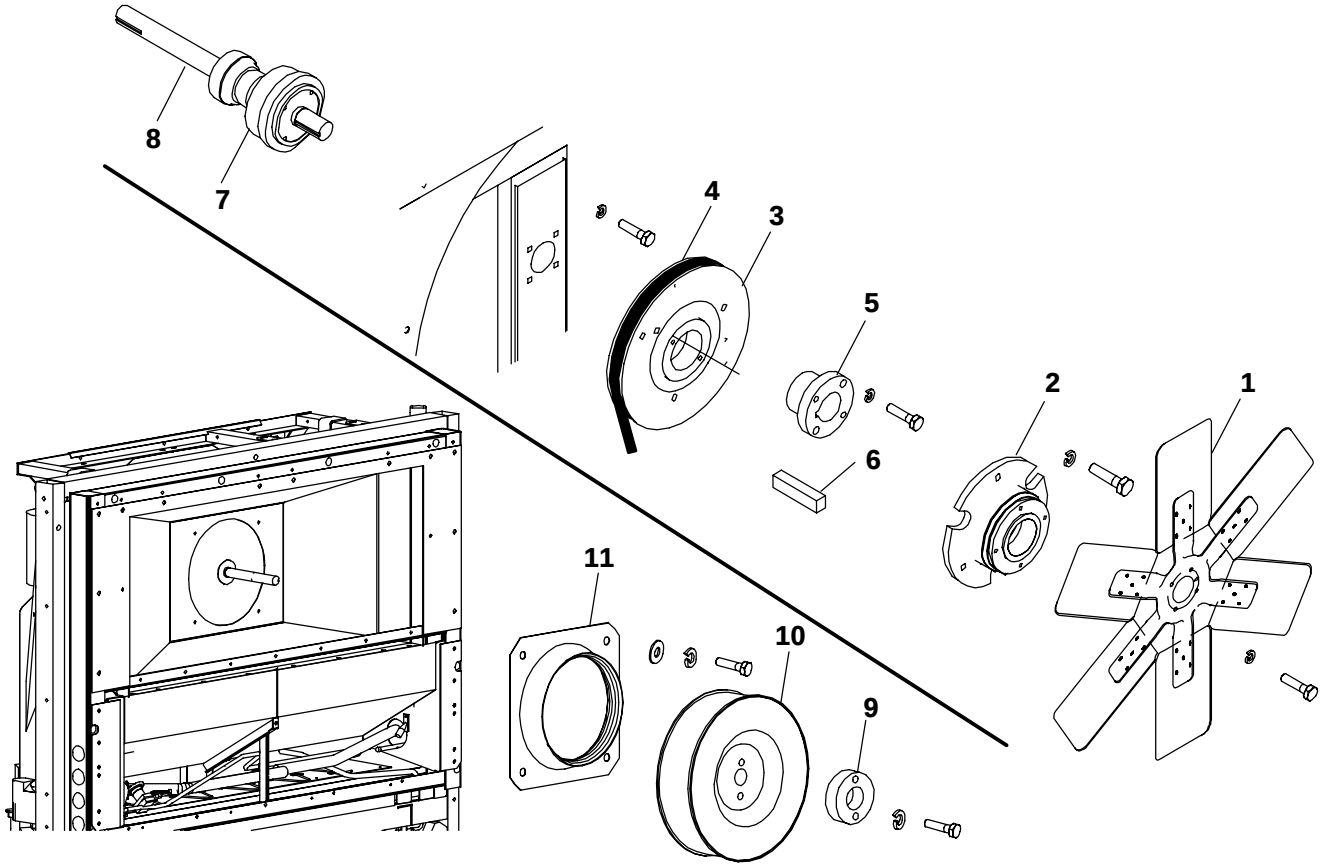
a. To Remove the Fan Shaft

1. Disconnect negative battery cable.
2. Remove 4 screws securing condenser fan (item 1, Figure 4-19) to adapter.
3. Remove V-Belt. (Refer to section 4.4.4.)
4. Remove 3 screws securing adapter (item 2).
5. Remove 3 screws securing sheave (item 3).
6. Remove tapered bushing (item 5).
7. Remove evaporator panels.
8. Remove two screws securing split tapered bushing, to blower wheel (items 10 and 11, Figure 4-19). Place the two screws in the threaded holes of the fan hub and use screws as jacking bolts to remove bushing from blower wheel.
9. Remove venturi ring (item 11, Figure 4-19) by removing 4 screws.
10. Remove 4 screws from the bearing housing (item 7, Figure 4-19).
11. Remove the shaft and bearing housing.
12. Install bearing housing assembly into unit by reversing steps 1 through 9 using caulk.
13. Locate the fan and key so that 1/3 of the condenser fan extends beyond the leaving edge of the fan shroud. Secure fan and hub to shaft.
14. Install evaporator fan venturi ring. Then install tapered hub and blower wheel loosely. Adjust blower wheel and tighten.
15. Install evaporator panels.

WARNING

Do not start unit without installing the evaporator panels as unit damage or body harm may result.

15. Start unit and check refrigeration cycle.



1. Condenser Fan
2. Adapter Condenser Fan
3. Sheave
4. V-Belt
5. Split Tapered Bushing
6. Key
7. Bearing Housing
8. Shaft
9. Bushing
10. Blower Wheel
11. Venturi Ring

Figure 4-19. Evaporator/Condenser Fan Shaft Assembly

4.22 EVAPORATOR COIL CLEANING

The use of recycled cardboard cartons is increasing across the country. The recycled cardboard cartons create much more fiber dust during transport than "new" cartons. The fiber dust and particles are drawn into the evaporator where they lodge between the evaporator fins. If the coil is not cleaned on a regular basis, sometimes as often as after each trip, the accumulation can be great enough to restrict air flow, cause coil icing, repetitive defrosts and loss of unit capacity. Due to the "washing" action of normal defrost the fiber dust and particles may not be visible on the face of the coil but may accumulate deep within.

It is recommended to clean the evaporator coil on a regular basis, not only to remove cardboard dust, but to remove any grease or oil film which sometimes coats the fins and prevents water from draining into the drain pan.

Cardboard fiber particles after being wetted and dried several times can be very hard to remove. Therefore, several washings may be necessary.

a. Remove rubber check valves (Kazoo) from drain lines (front of trailer).

b. Spray coil with a mild detergent solution such as Oakite 164 or any good commercial grade automatic dish washer detergent such as Electrosol or Cascade and let the solution stand for a few minutes and reverse flush (opposite normal air flow) with clean water at mild pressure. A garden hose with spray nozzle is usually sufficient. Make sure drain lines are clean.

c. Run unit until defrost mode can be initiated to check for proper draining from drain pan. (Refer to section 2)

4.23 CONDENSER COIL CLEANING

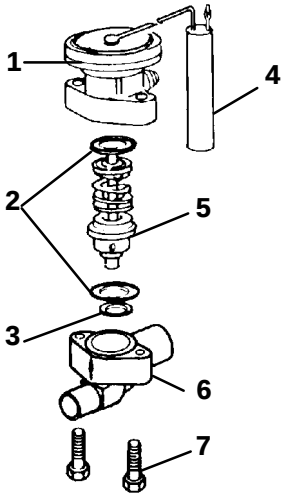
Remove all foreign material from the condenser coil by reversing the normal air flow. (Air is pulled in through the front and discharges over the engine.) Compressed air or water may be used as a cleaning agent. It may be necessary to use warm water mixed with any good commercial dishwasher detergent. Rinse coil with fresh water if a detergent is used.

4.24 THERMOSTATIC EXPANSION VALVE

The thermal expansion valve is an automatic device which maintains constant superheat of the refrigerant gas leaving the evaporator regardless of suction pressure. The valve functions are: (a) automatic response of refrigerant flow to match the evaporator load and (b) prevention of liquid refrigerant entering the compressor. Unless the valve is defective, it seldom requires any maintenance.

a. Replacing Expansion Valve

1. Pump down the unit by closing the King valve. (Refer to section 4.5.a)
2. Remove insulation (Presstite) from expansion valve bulb and then remove bulb from suction line.
3. Loosen flare nut and disconnect equalizer line from expansion valve.
4. Remove flange screws and lift off power assembly. Then remove the cage assembly. Check for foreign material in valve body.
5. The thermal bulb is located below the center of the suction line (See Figure 4-21). This area must be clean to ensure positive bulb contact. Strap thermal bulb to suction line and insulate both with Presstite.



1. Power Assembly
2. Body Flange Gaskets
3. Seat Gasket
4. Bulb
5. Cage Assembly
6. Body Flange
7. Body Flange Screws

Figure 4-20. Thermostatic Expansion Valve

6. Install new gaskets and insert cage assembly and install power assembly.
7. Fasten equalizer tube to expansion valve.
8. Evacuate by placing vacuum pump on suction service valve.
9. Open King valve and then check refrigerant level. (Refer to section 4.9.b)
10. Check superheat. (Refer to section 1.3.h)

b. Checking Superheat

NOTE

It is not recommended adjusting expansion valves unless absolutely necessary.

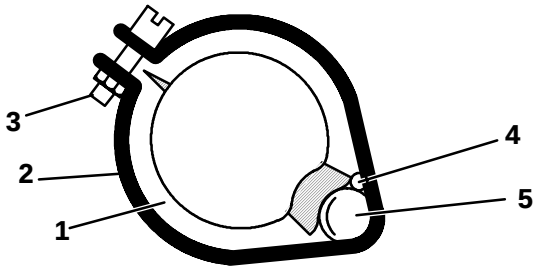
Due to the time involved in adjusting the superheat, replace the valve rather than adjusting it.

c. To Measure Superheat

NOTE

The expansion valve and bulb location are shown in Figure 1-6.

1. Remove evaporator panel from rear of unit and then remove Presstite from expansion valve bulb and suction line.
2. Loosen one TXV bulb clamp and make sure area under clamp (above TXV bulb) is clean.
3. Place thermocouple above (parallel) TXV bulb and then secure loosened clamp making sure both bulbs are firmly secured to suction line as shown in Figure 4-21.



1. Suction Line (end view)
2. TXV Bulb Clamp
3. Nut and Bolt (clamp)
4. Thermocouple
5. TXV Bulb

Figure 4-21. Thermostatic Expansion Valve Bulb and Thermocouple

NOTE

When conducting this test the suction pressure must be 6 psig (0.4 kg/cm@) below expansion valve maximum operating pressure (MOP). For example: R-22 units use an expansion valve with a 35 MOP. The recommended test pressure should be below 49 psig(3.44 kg/cm@).

4. Connect an accurate gauge to the 1/4" port on the suction service valve.
5. Run unit until stabilized. Set controller 10_F (5.5_C) below box temperature.
6. From the temperature/pressure chart, determine the saturation temperature corresponding to the evaporator outlet pressure.
7. Note the temperature of the suction gas at the expansion valve bulb.

Subtract the saturation temperature determined in Step 6 from the average temperature measured in Step 7. The difference is the superheat of the suction gas.

d. Adjusting Superheat on Remote Evaporators

One thirds Dual flow and three thirds Dual flow evaporators have two expansion valves per evaporator.

CAUTION

Make sure only one evaporator is operating. No obstruction to the airflow should be present.

The unit should be in cooling.

The unloaders should be disconnected if fitted to make sure compressor is working at maximum efficiency.

The Superheat check should be carried out inside a workshop or with a minimum air ambient of 41˚F (5˚C).

The coil should be clean and free of ice.

Remove the Presstolite from the bulb and loosen the clamps. Put a thermocouple above (parallel) TXV bulb next to the bulb. Retighten clamp and re-insulate with Presstolite. Make the standard adjustment to the expansion valve which is to unscrew completely the superheat setting screw in the counter-clockwise direction. Then, tighten three turns (3X360˚) in the clockwise direction.

Allow the unit to stabilize at 32˚ F (0˚C), making sure that the unit is in cooling.

Note the temperature of the suction gas at the expansion valve bulb.

Subtract the saturation temperature taken from the suction gauge to determine superheat.

Adjust each valve, a ¼ turn at a time, allowing the unit to stabilize between adjustments.

4.25 REPLACING EVAPORATOR FAN MOTOR

Remove two retaining screws which hold the door assembly in position. The complete hinged assembly drops down, allowing access to the fan.

Disconnect wires in terminal box relative to fan being removed. Remove four bolts and fan assembly.

Fit new fan to mounting plate. Install fan assembly into evaporator.

4.26 EVAPORATOR ELECTRICAL CONNECTIONS

All wiring harnesses to the evaporator section are identical. The only difference is the length.

WARNING

For safety, when disconnecting the harness at the condensing section end for testing purposes, always leave the separate earth cable connected.

A seventeen core cable is provided with a multi-pin connector on one end to connect directly to the condensing section. The other end of the cable is color coded to allow easy connection in the evaporator. When there are two wires of the same color, they will be numbered: i.e. yellow (1) yellow (2) / brown (1) brown (2)

Table 4-2. Evaporator Electrical Connections

Pin	Color	Wire
25A	Yellow 1	Defrost termination sensor
20A	Yellow 2	
26B	Brown 1	Return air sensor (B)
21B	Brown 2	Return air sensor (A)
24A	Orange	not used
22B	Grey	Door switch
1C	Red1	Heater element
23B	White	Liquid line solenoid valve
3C	Red2	Heater element
16C	Purple	Drain water heater
–	Red3	Heater element
17B	Dark blue	Door switch
–	Green	Earth
7C	Blue	Fans
9C	Brown	Fans
–	Green/Yellow	Earth

4.27 MICROPROCESSOR CONTROLLER

NOTE

The erasable, programmable, read only memory (EPROM) chip (component U3 on the microprocessor logic board) has a window on it which is covered with a label listing the revision level of the software. The window is used to erase the chip's memory with the use of ultraviolet light. the label prevents light from entering the chip and erasing the memory. Under NO circumstances should this label be removed.

CAUTION

Under no circumstances should a technician electrically probe the processor at any point, other than the connector terminals where the harness attaches. Microprocessor components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity testers, etc. could permanently damage the processor.

As mentioned above, some microprocessor inputs operate at voltage levels other than the conventional 12 vdc. Connector points and the associated approximate voltage levels are listed below for reference only. Under no circumstances should 12 vdc be applied at these connection points.

Grounded wrist cuffs are available at most radio, computer and electronic supply stores. It is recommended that these be worn whenever handling a microprocessor.

Table 4-3. Connection Point Voltage

Connection Point	Approximate Voltage
CDT, RAS, SAS, WTS	2.5 vdc (Variable)
MPF1	5.0 vdc

CAUTION

Most electronic components are susceptible to damage caused by electrical static discharge (ESD). In certain cases, the human body can have enough static electricity to cause resultant damage to the components by touch. This is especially true of the integrated circuits found on the truck/trailer microprocessor.

Although there is less danger of electrical static discharge ESD damage in the outdoor environment, where the processor is likely to be handled, proper board handling techniques should always be stressed. Boards should always be handled by their edges, in much the same way one would handle a photograph. This not only precludes the possibility of ESD damage, but also lowers the possibility of physical damage to the electronic components. Although the microprocessor boards are fairly rugged when assembled, they are more fragile when separated and should always be handled carefully.

During emergency situations, the test board may be used to keep a unit running and prevent a critical load from spoiling. Since the microprocessor is totally disconnected from the unit, it cannot monitor the engine's safety switches for oil pressure and coolant temperature. *Since the engine is running unprotected when the test board is used,* it is imperative that should a problem develop with the microprocessor, it be replaced immediately. *The test board is intended to be a trouble-shooting tool only.*

When using the test board to troubleshoot, the unit should be started in low speed, unloaded cool in the same way as the processor would start the unit. *Good judgment should also be used when cycling any unit with the test board. Rapid cycling should be avoided.*

When welding is required on the unit frame, or on the front area of the trailer, ALL wiring to the microprocessor MUST be disconnected. When welding is performed on other areas of the trailer, the welder ground connection MUST be in close proximity to the area being welded. It is also a good practice to remove both battery cables before welding on either the unit frame or the trailer to prevent possible damage to other components such as the alternator and voltage regulator.

a. Replacing Key Board

Should damage to the Key Board of the microprocessor occur, it is possible to replace only the Key Board.

All replacement key boards are packaged with replacement O-Ring. The recommended torque for securing nuts or bolts is 15 inch-lbs.

b. Hour Meters

The hour meter can be set to any value via the serial port, if the meter has less then 5 hours on it. This allows a replacement microprocessor to be set to the same hours as the microprocessor it is replacing.

The microprocessor has 2 programmable registers which are set via the serial port. These registers are compared to one of the hour meters (diesel, standby, or switch on). If the hour meter is greater than the register then the proper alarm is set.

4.28 CONFIGURATION of MICROPROCESSOR

When replacing a microprocessor it is important to check that the configurations are compatible for the unit into which it will be installed. (This same board fits both trailer and truck model units.) All configuration fields should be viewed before starting the unit.

a. To reach the configuration fields:

1. Turn the Run/Stop switch to the Stop position.
2 With the unit off, locate the serial port plug located below the control panel. Remove the protective plug to gain access to the wire terminals. Place an insulated jumper wire between wires SPA and SPB at the serial port plug.

CAUTION

Do not allow jumper wire to touch any ground.

3. Turn the Run/Stop switch to the Run position. The FAULT light will come on, and the micro display will read "CNF1 TV" or "CNF1 DI". Remove the jumper wire from the serial port and reinstall the protective plug. The configuration screen will now remain available for 5 minute. Scroll through the configuration list using the FUNCTION key and compare the settings with those shown on the table in the next column. If any of the configurations need to be changed continue with step (b.) below.

b. To change the configuration selection:

1. Bring the configuration to be changed onto the display. Press the ENTER key to allow change access to the displayed configuration.
2. Press either the UP or DOWN keys to display available selections for that configuration. Leave the correct selection on the screen. The selection display will flash warning the operator that the displayed value has not been entered. Press the ENTER key to enter the new selection into memory. (The display will revert to the original selection if no further action is taken for the next 5 seconds.)
3. Continue to scroll through the configuration list by pressing the FUNCTION key. Change any other configurations as required.
4. When finished turn the Run/Stop switch to the Stop position, then back to the Run position to start the unit.

Table 4-4. Microprocessor Configuration

Configuration		Description
CNF1	DI	DI Engine Glow Time
	TV	TV Engine Glow Time
CNF2	OFF	CDT not used
	ON	CDT used
*CNF3	OFF	86_ Setpoint
	ON	90_ Setpoint
CNF4	OFF	Heat lockout on +10_F
	ON	Heat lockout off (Truck units)
**CNF5	OFF	MOP Disabled (R-502)
	ON	MOP Enabled (R-22/R-404A)
CNF6	OFF	Trailer unit
	ON	Truck unit
CNF7	OFF	High speed start (Truck unit)
	ON	Low speed start (Trailer unit)
CNF8	OFF	Belt driven fans
	ON	Electric fan motors
CNF9	OFF	Out-of-range alarm
	ON	Out-of-range alarm and unit shut down
CNF10	OFF	MOP Software Values (Must be Off)
	ON	MOP EEPROM Values (Do not turn on)
*CNF11	OFF	Functions normal
	ON	Functions locked
CNF12	OFF	MOP R-22
	ON	MOP R-404A
CNF13	OFF	Cool/Heat/Defrost
	ON	Heat Only (Solara)
CNF14	OFF	Not Active
	ON	Reversible Multi-Temp Active
CNF15	OFF	Not Active
	ON	UltraFresh 2 Active
CNF16	OFF	Alt aux alarm only
	ON	Alt aux alarm shut unit down

*With software revision 3.15 or higher when configurations CNF3 & CNF11 are "ON" and setpoint is 32 to 42_ F (0 to 5.5_C), the unit is locked into continuous run. Start/Stop Continuous key is disabled in this setpoint range.

**With software revision 3.15 or higher when configurations CNF5 is "OFF" then, MOP and Ultrafreeze are turned off. The evaporator pump down cycles used for standby heat and standby defrost are de- activated. In diesel mode, the high ambient defrost algorithm is not used.

4.29 CONTROLLER SENSOR CHECKOUT

An accurate ohmmeter must be used to check resistance values shown in Table 4-5.

Due to variations and inaccuracies in ohmmeters, thermometers or other test equipment, a reading within 2% of the chart value would indicate a good sensor. If a sensor is bad, the resistance reading will usually be much higher or lower than the resistance values given in Table 4-5.

At least one lead from the sensor (RAS, terminals D1 and E1 or SAS, terminals D2 and E2) must be disconnected from the unit electrical system before any reading is taken. Not doing so will result in a false reading. Two preferred methods of determining the actual test temperature at the sensor, is an ice bath at 32_F (0_C) or a calibrated temperature tester.

Table 4-5. Sensor Resistance (ATS, CDT, RAS, SAS, & WTS)

Temperature		ATS, RAS, SAS & WTS Resistance In Ohms	CDT Resistance In Ohms
_F	_C		
–20	–28.9	165,300	1,653,000
–10	–23.3	117,800	1,178,000
0	–17.8	85,500	855,000
10	–12.2	62,400	624,000
20	– 6.7	46,300	463,000
30	– 1.1	34,500	345,000
32	0	32,700	327,000
40	4.4	26,200	262,000
50	10.0	19,900	199,000
60	15.6	15,300	153,000
70	21.1	11,900	119,000
77	25	10,000	100,000
80	26.7	9,300	93,000
90	32.2	7,300	73,000
100	37.8	5,800	58,000
110	43.3	4,700	47,000
120	48.9	3,800	38,000
194	90	915	9,150
212	100	680	6,800
266	130	301	3,010
302	150	186	1,860

4.30 SUCTION PRESSURE TRANSDUCER

Before installing a new suction pressure transducer it must be calibrated.

The calibration will not be performed if the run relay is energized. This prevents the operator from calibrating the unit with the sensor in the system. The reading of the sensor must be at atmospheric pressure (0 psig or 14.7 psi). If the sensor reading is greater than 20 psig (34.7 psi) or less than –6.7 psig (8 psi) it can not be calibrated. Once the micro is calibrated, the display will readout the actual value.

1. Turn power off and remove starter solenoid wire, then let unit fail to start. This will de-energize run relay.
2. Connect wiring to new suction pressure transducer. Before installing suction pressure transducer into compressor, display the suction pressure via the unit status display. While the suction pressure is being displayed press ENTER key for 3 seconds, the display should read “0”. If display reads “0” install suction pressure transducer into compressor.

Table 4-6. Suction Pressure Transducer Voltage

Psig	Voltage	Psig	Voltage	Psig	Voltage
20”	0.369	30	0.761	70	1.155
10”	0.417	35	0.810	75	1.204
0	0.466	40	0.860	80	1.253
5	0.515	45	0.909	85	1.303
10	0.564	50	0.958	90	1.352
15	0.614	55	1.007	95	1.401
20	0.663	60	1.056	100	1.450
25	0.712	65	1.106		

4.31 UNIDRIVE TORQUE REQUIREMENTS (See Figure 4-22)

Extensive damage may occur if the proper hardware and procedures are not followed. Periodic inspection of hardware and bolt torque is recommended to insure the integrity of the unidrive.

NOTE

Thread locking sealant, 5/16 flat washer and 5/16 lock washer *must* be used on bolts between the compressor mounting flange and the adapter spacers. The recommended sealant is Loctite screw lock no. 262.

The figure below shows the torque value, size and grade of the hardware to be used when reassembling the unidrive assembly.

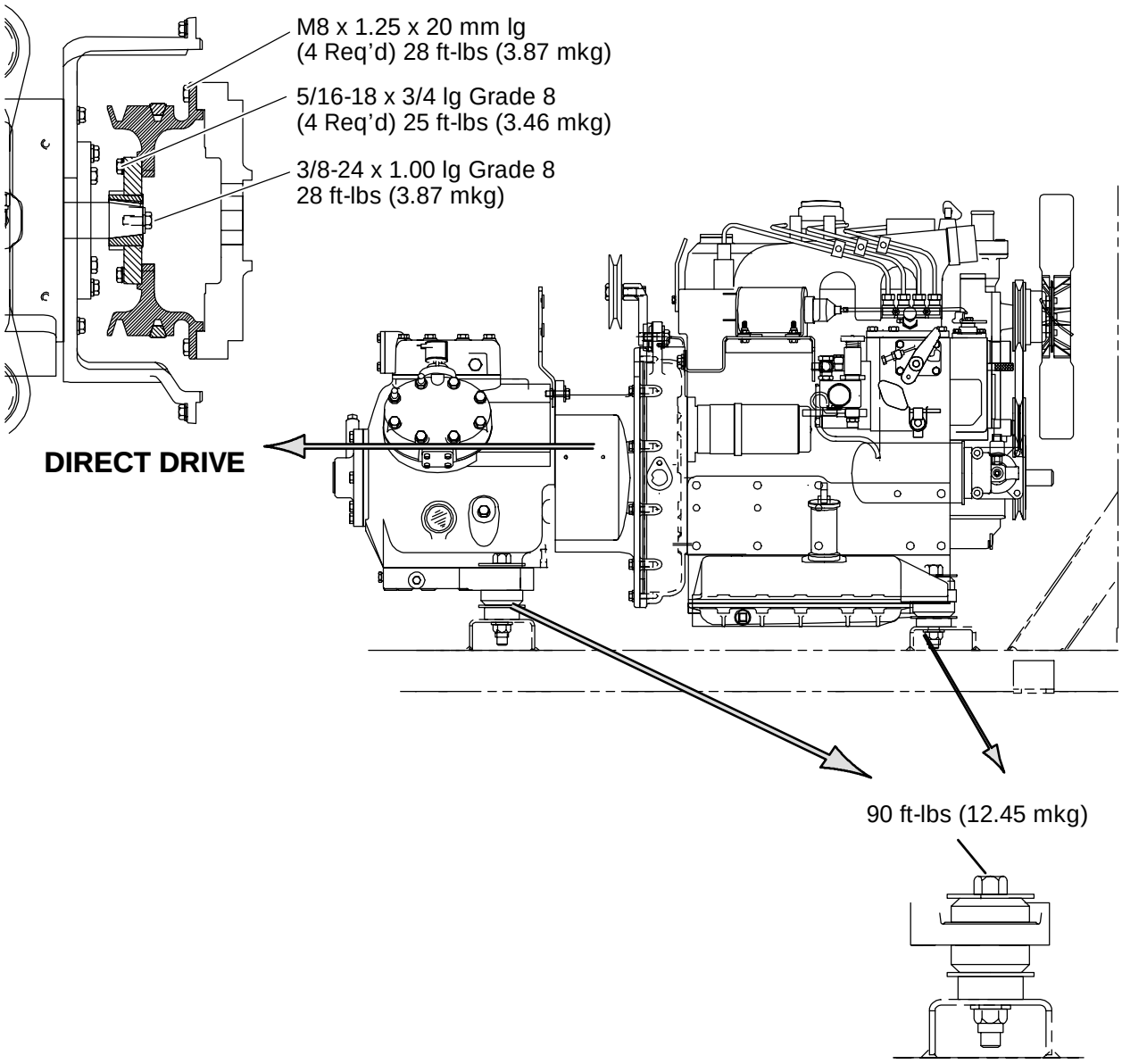


Figure 4-22. Unidrive Torque Requirements

4.32 SERVICING LIQUID SOLENOID VALVE (LSV)

NOTE

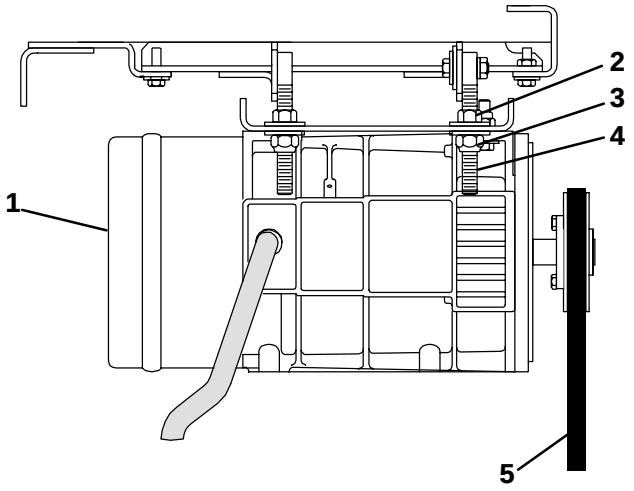
The liquid solenoid valve (LSV) is the same valve as (SV2). Refer to section 4.17 for servicing.

4.33 REPLACING OR ADJUSTING GENERATOR BELT

a. Loosen locknut on adjusting screw (Item 3, Figure 4-23) enough to clear generator V-belt from the sheave.

b. To remove generator V-belt from drive shaft, follow instructions in section 4.4. (See Figure 4-7)

c. After replacing belt, take up on jam nut and locknut on adjusting screw until a belt tension of 70 to 80 ft-lbs is maintained.



1. Generator 5kw
2. Jam Nut
3. Locknut
4. Adjusting Screw
5. V-Belt

Figure 4-23. Generator

4.34 5KW GENERATOR MAINTENANCE

The 5KW generator require very little preventative maintenance to insure good performance.

1. Belt tension should be maintained at 70 to 80 ft-lbs Refer to section Figure 4-23.
2. The generator is equipped with an air filter located under the black plastic housing at the back of the generator. Air is drawn through this filter as the generator operates, and keeps all internal components cool. Any restriction caused by a dirty filter can result in generator overheating problems.

The air filter should be removed and cleaned with warm water and soap, then rinsed well, at every regularly scheduled service interval (at least once a year), or more frequently depending on environmental conditions (more often in dusty conditions), in order to protect against over-heating of the capacitor and generator windings.

When trouble-shooting the 5KW generator, it is important to check the internal capacitor, the forward/reverse rotating diodes, and the internal windings.

The forward/reverse rotating diodes are located at the filter end of the generator. The reverse diode is marked with a red dot on the solder terminal. The forward diode is unmarked. A faulty diode will give a short circuit or open circuit reading in both directions.

Generally premature capacitor failure can be attributed to over-speeding or over-heating of the generator. The maximum speed for the generator is 3600 rpm. Setting engine speed on multi-temp units is critical to proper operation of the generator. The engine speed should be set to 1700 rpm with unit operating in fully loaded cool mode, with all compartments turned on. Refer to Table 4-7 for corresponding generator voltage output.

Table 4-7. Generator Voltage Output

UNIT	Engine RPM	Generator RPM	Volts
R-22	1700	3600	240
R-404A	1700	3300	210

A generator fault finding guide is shown in Figure 4-24. This should be used whenever troubleshooting a problem with a 5KW generator.

4.34.1 Generator Flashing

In the event of voltage output failure, the generator may have lost its residual magnetism. This loss can be restored by "flashing" the generator by following these steps:

1. Shut the unit OFF and turn the remote compartment power switch OFF.
2. Connect an A.C. voltmeter to the generator output wires at the high voltage fuse block.
3. Connect two (2) jumper wires, one to each of the generator capacitor terminals.
4. Start the unit and run in high speed; leave the remote compartment power OFF.
5. Touch one jumper wire to a 12vdc ground connection.
6. Touch the other jumper wire to a 12vdc positive connection.

WARNING

The jumpers should only be connected to 12vdc for no longer than one(l) second in order to flash the generator and restore the residual magnetism required for generator output.

7. Observe the voltmeter; the voltage should increase to approximately 220vac.
8. Shut the unit OFF and disconnect the jumper wires.
9. Restart the unit; run in high speed and check the generator voltage output and rear compartment heater amperage.

ROTOR	MAIN STATOR PER SECTION	AUXILIARY WINDING
10.7 Ohms	0.89 Ohms	1.18 Ohms
The rotating diodes can be tested during this same operation. The diode(s) must be removed from the circuit to test either diode or rotor winding resistance.	Disconnect each lead and test resistance between U1 & U2 and U5 & U6. (Note: unit wiring must be disconnected from generator for this test.)	Remove the wires from capacitor to test.

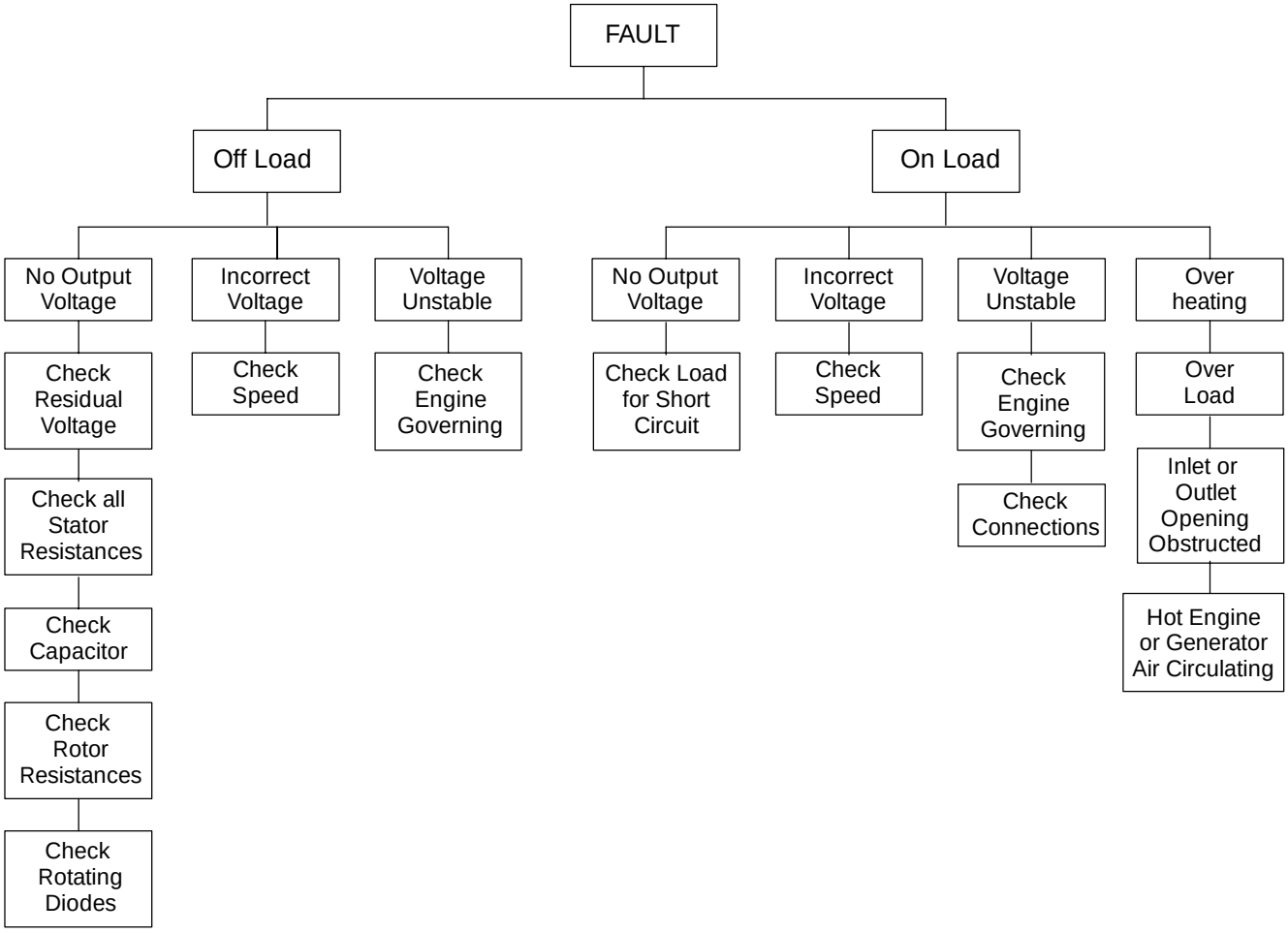
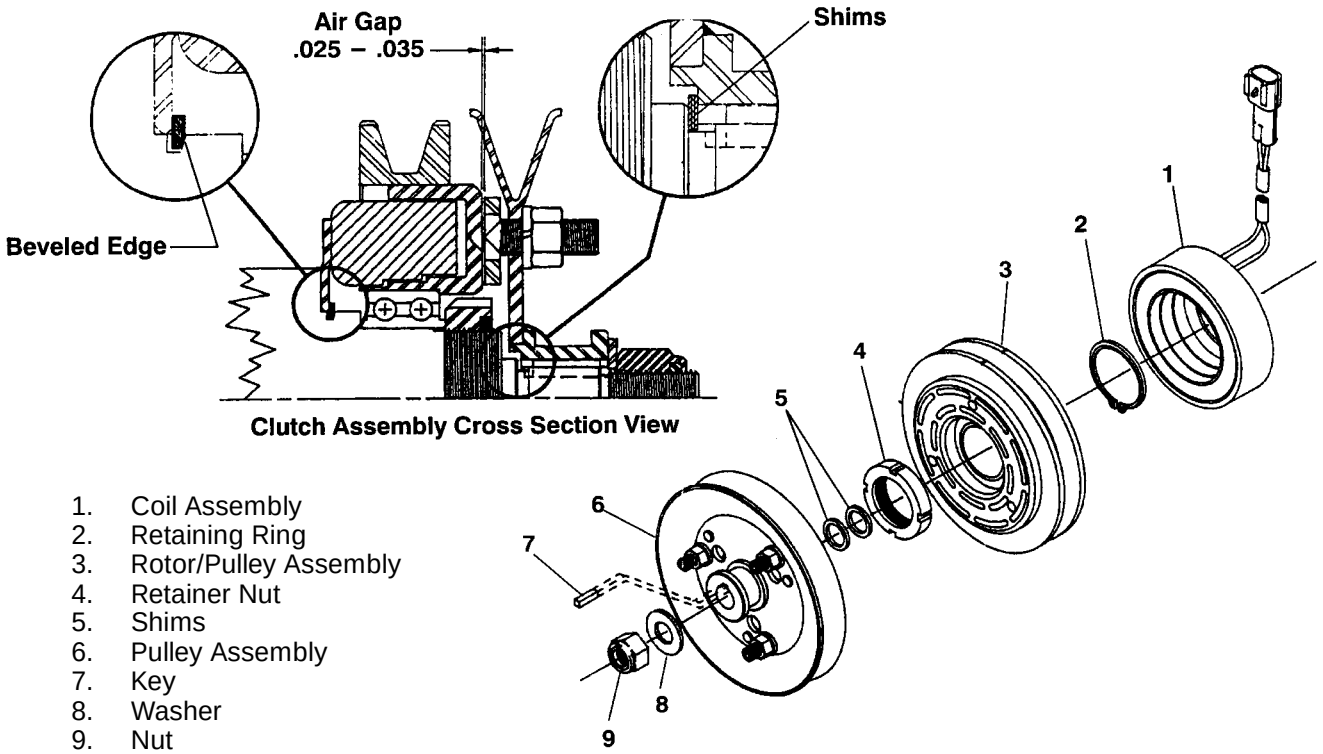


Figure 4-24. Generator Fault Finding Guide

4.35 GEARBOX CLUTCH



1. Coil Assembly
2. Retaining Ring
3. Rotor/Pulley Assembly
4. Retainer Nut
5. Shims
6. Pulley Assembly
7. Key
8. Washer
9. Nut

Figure 4-25. Gearbox Clutch

a. Clutch Removal

1. Disconnect electrical input.
2. Remove armature/pulley assembly (Figure 4-25, 6)
   a. Remove shaft nut (9) and washer (8).
   b. Using a standard 2– or 3–jaw gear puller, pull the armature (6) off the shaft. Apply the puller jaws to the pulley hub, not the rim of the pulley. **NOTE: The armature pulley has been loctited to the shaft.**
   c. Remove the shaft key (7) and shims (5).
3. Remove rotor/pulley assembly (3)
   a. Remove bearing retainer nut (4) using removal tool.
   b. Slide rotor/pulley assembly (3) from gearbox housing.
4. Remove the field coil assembly (1)
   a. Remove field coil assembly retaining ring (2).
   b. Remove field coil assembly (1) from gearbox.

b. Clutch Installation

1. Install field coil assembly (1)
   a. Place field coil assembly (1) on pilot diameter of gearbox. Align slot in field coil assembly with locator pin in gearbox housing.
   b. Install field coil retaining ring (2). **IMPORTANT: The retaining ring's beveled or tapered edge must face away from the gearbox to obtain proper retention force.**
2. Install rotor/pulley assembly (3)
   a. Slide rotor/pulley onto gearbox housing. **DO NOT POUND** on rotor assembly; rock back and forth gently with hand pressure until unit slides on.
   b. Install bearing retainer nut (4). Tighten nut to 65 lb-ft. Rotor should spin free without noise.
3. Install armature/pulley assembly (6)
   a. Slide armature assembly (6) onto gearbox shaft. Measure air gap between armature face and rotor face using a wire type feeler gauge. Three access holes are provided in the pulley face.
   b. If the air gap is less than 0.025 in., remove armature assembly and add shim(s) (5) to shaft as shown in Figure 4-25. Use only new shims.
   c. Repeat steps a. and b. until an average air gap of 0.025 to 0.035 in. is obtained.
   d. Install a new key (7) in shaft.
   e. Apply Loctite #609 to shaft and pulley hub bore. Slide armature/pulley onto gearbox shaft.
   f. Install washer (8) and lock nut (9). NOTE: two types of locking nuts may be used –
   - Standard nylon locknut uses flat washer and requires 65–70 ft/lbs. torque.
   - Upset thread type with integral washer DOES NOT use a separate washer and requires 55–60 ft/lbs. torque – DO NOT over–tighten this type.

Table 4-8. R-22 Pressure -- Temperature Chart

TEMPERATURE		PRESSURE			TEMPERATURE		PRESSURE		
_F	_C	Psig	Kg/cm@	Bar	_F	_C	Psig	Kg/cm@	Bar
−40	−40	.6	.04	.04	34	1	60.5	4.25	4.17
−36	−38	2.3	.16	.16	36	2	63.3	4.45	4.36
−32	−36	4.1	.29	.28	38	3	66.1	4.65	4.56
−28	−33	6.0	.42	.41	40	4	69	4.85	4.76
−26	−32	7.0	.49	.48	44	7	75.0	5.27	5.17
−24	−31	8.1	.57	.56	48	9	81.4	5.72	5.61
−22	−30	9.2	.65	.63	52	11	88.1	6.19	6.07
−20	−29	10.3	.72	.71	54	12	91.5	6.43	6.31
−18	−28	11.5	.81	.79	60	16	102.5	7.21	7.07
−16	−27	12.7	.89	.88	64	18	110.2	7.75	7.6
−14	−26	14.0	.98	.97	68	20	118.3	8.32	8.16
−12	−24	15.2	1.07	1.05	72	22	126.8	8.91	8.74
−10	−23	16.6	1.17	1.14	76	24	135.7	9.54	9.36
− 8	−22	18.0	1.27	1.24	80	27	145	10.19	10.0
− 6	−21	19.4	1.36	1.34	84	29	154.7	10.88	10.67
− 4	−20	21.0	1.48	1.45	88	31	164.9	11.59	11.37
− 2	−19	22.5	1.58	1.55	92	33	175.4	12.33	12.09
0	−18	24.1	1.69	1.66	96	36	186.5	13.11	12.86
2	−17	25.7	1.81	1.77	100	38	197.9	13.91	13.64
4	−16	27.4	1.93	1.89	104	40	209.9	14.76	14.47
6	−14	29.2	2.05	2.01	108	42	222.3	15.63	15.33
8	−13	31.0	2.18	2.14	112	44	235.2	16.54	16.22
10	−12	32.9	2.31	2.27	116	47	248.7	17.49	17.15
12	−11	34.9	2.45	2.41	120	49	262.6	18.46	18.11
14	−10	36.9	2.59	2.54	124	51	277.0	19.48	19.10
16	− 9	39.0	2.74	2.69	128	53	291.8	20.52	20.12
18	− 8	41.1	2.89	2.83	132	56	307.1	21.59	21.17
20	− 7	43.3	3.04	2.99	136	58	323.6	22.75	22.31
22	− 6	45.5	3.2	3.14	140	60	341.3	24.0	23.53
24	− 4	47.9	3.37	3.3	144	62	359.4	25.27	24.78
26	− 3	50.2	3.53	3.46	148	64	377.9	26.57	26.06
28	− 2	52.7	3.71	3.63	152	67	396.6	27.88	27.34
30	− 1	55.2	3.88	3.81	156	69	415.6	29.22	28.65
32	0	57.8	4.06	3.99	160	71	434.6	30.56	29.96

Table 4-9. R-404A Temperature--Pressure Chart

Temperature		Pressure		
_F	_C	Psig	Kg/cm@	Bar
−40	−40	4.5	0.32	0.31
−35	−37	7.1	0.50	0.49
−30	−34	9.9	0.70	0.68
−25	−32	12.9	0.91	0.89
−20	−29	16.3	1.15	1.12
−18	−28	17.7	1.24	1.22
−16	−27	19.2	1.35	1.32
−14	−26	20.7	1.46	1.43
−12	−24	22.3	1.57	1.54
−10	−23	23.9	1.68	1.65
−8	−22	25.6	1.80	1.77
−6	−21	27.3	1.92	1.88
−4	−20	29.1	2.05	2.01
−2	−19	30.9	2.17	2.13
0	−18	32.8	2.31	2.26
2	−17	34.8	2.45	2.40
4	−16	36.8	2.59	2.54
6	−14	38.9	2.73	2.68
8	−13	41.1	2.89	2.83
10	−12	43.3	3.04	2.99
12	−11	45.6	3.21	3.14
14	−10	48.0	3.37	3.31
16	−9	50.4	3.54	3.47
18	−8	52.9	3.72	3.65
20	−7	55.5	3.90	3.83
22	−6	58.1	4.08	4.01
24	−4	60.9	4.28	4.20
26	−3	63.7	4.48	4.39
28	−2	66.5	4.68	4.59
30	−1	69.5	4.89	4.79

Temperature		Pressure		
_F	_C	Psig	Kg/cm@	Bar
32	0	72.5	5.10	5.00
34	1	75.6	5.32	5.21
36	2	78.8	5.54	5.43
38	3	82.1	5.77	5.66
40	4	85.5	6.01	5.90
42	6	89.0	6.26	6.14
44	7	92.5	6.50	6.38
46	8	96.2	6.76	6.63
48	9	99.9	7.02	6.89
50	10	103.7	7.29	7.15
55	13	115.4	8.11	7.96
60	16	126.1	8.87	8.69
65	18	137.4	9.66	9.47
70	21	149.4	10.50	10.30
75	24	162.1	11.40	11.18
80	27	175.5	12.34	12.10
85	29	189.6	13.33	13.07
90	32	204.5	14.38	14.10
95	35	220.2	15.48	15.18
100	38	236.8	16.65	16.33
105	41	254.2	17.87	17.53
110	43	272.4	19.15	18.78
115	46	291.6	20.50	20.11
120	49	311.8	21.92	21.50
125	52	332.9	23.41	22.95
130	54	355.0	24.96	24.48
135	57	378.1	26.58	26.07
140	60	402.3	28.28	27.74
145	63	427.6	30.06	29.48
150	66	454.0	31.92	31.30

SECTION 5
ELECTRICAL SCHEMATIC WIRING DIAGRAM

5.1 INTRODUCTION

This section contains Electrical Schematic Wiring Diagram covering the Models listed in Table 1-1. The following supplement the specific warnings and cautions appearing elsewhere in this manual. They are recommended precautions that must be understood and applied during operation and maintenance of the equipment covered herein.

WARNING

High voltage in electrical box, disconnect power before servicing unit.

WARNING

Beware of V-belts and belt driven components as the unit may start automatically. Before servicing unit, make sure the Run-Stop switch is in the STOP position. Also disconnect the negative battery cable.

WARNING

Beware of unannounced starting of the evaporator and condenser fan.

WARNING

Make sure power to unit is OFF and negative battery cable is disconnected before servicing the compressor unloader.

CAUTION

Under no circumstances should anyone attempt to repair the logic or display boards! Should a problem develop with these components, contact your nearest Carrier Transicold dealer for replacement.

CAUTION

Under no circumstances should a technician electrically probe the processor at any point, other than the connector terminals where the harness attaches. Microprocessor components operate at different voltage levels and at extremely low current levels. Improper use of voltmeters, jumper wires, continuity testers, etc. could permanently damage the processor.

CAUTION

Observe proper polarity when installing battery, negative battery terminal must be grounded. Reverse polarity will destroy the rectifier diodes in alternator. As a precautionary measure, disconnect positive battery terminal when charging battery in unit. Connecting charger in reverse will destroy the rectifier diodes in alternator.

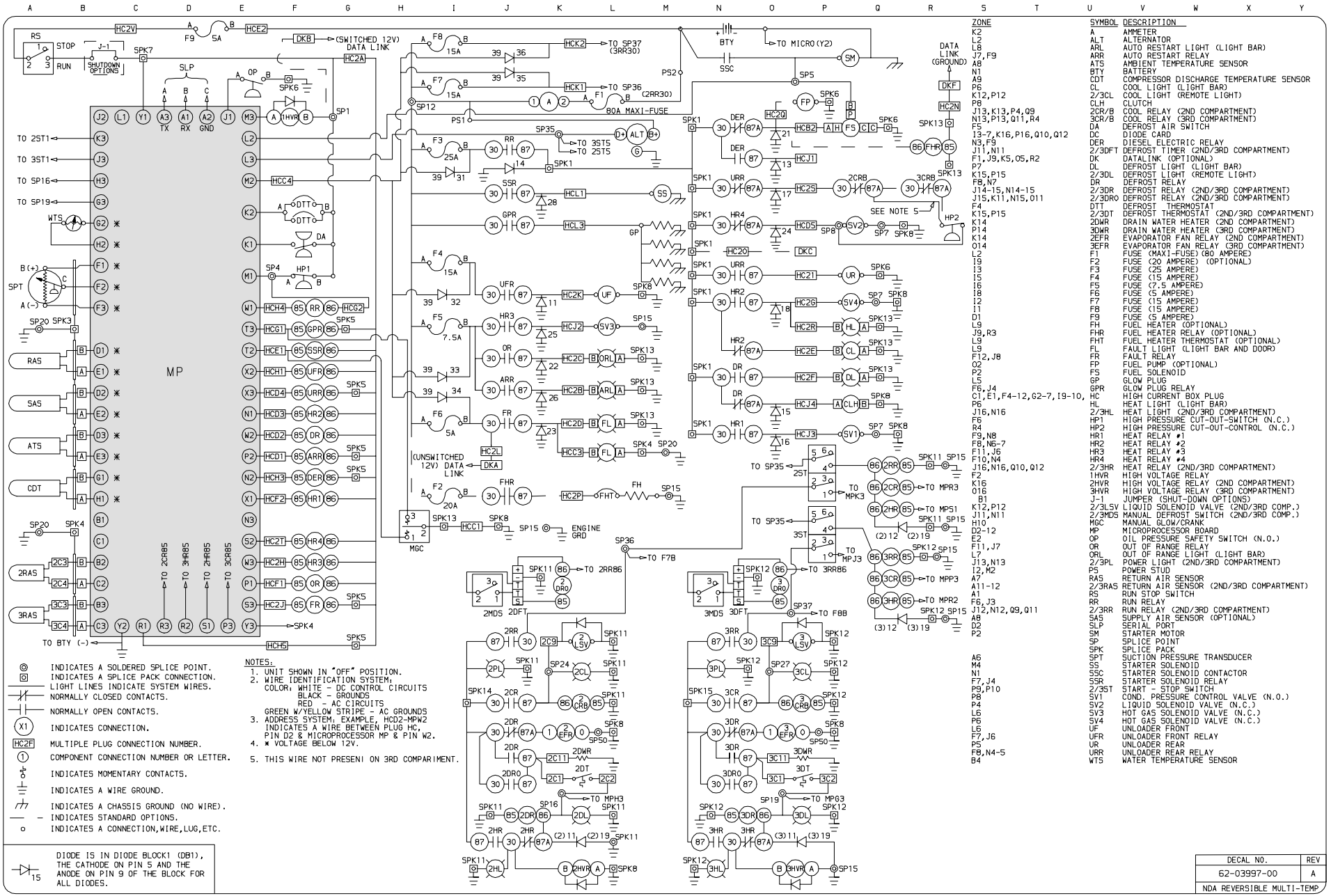


Figure 5-1. Electrical Schematic Wiring Diagram -- Dwg. No. 62-03997 -- NDA Prior to S/N FAC90391017

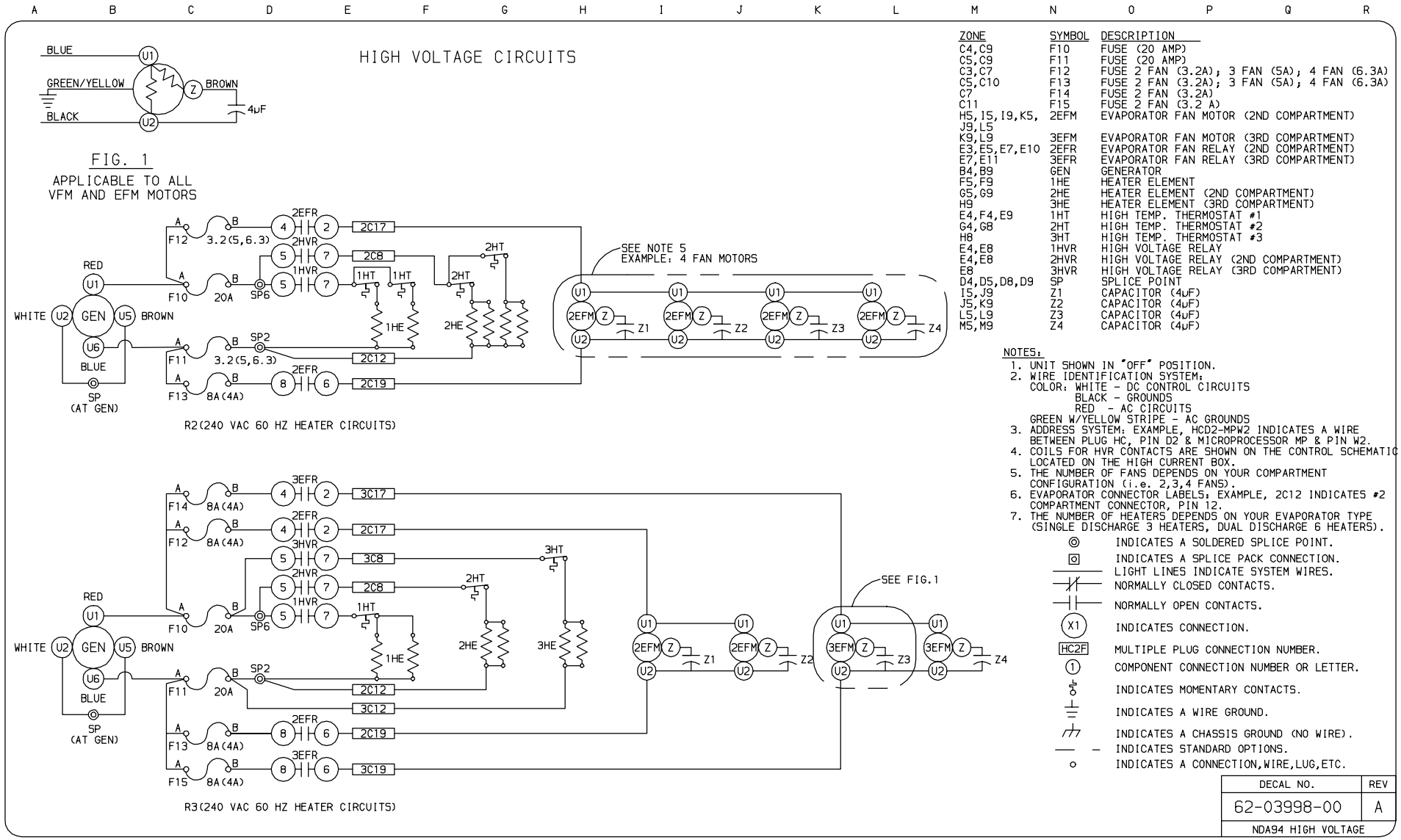


Figure 5-2. Electrical Schematic Wiring Diagram -- Dwg. No. 62-03998 -- NDA Prior to S/N FAC90391017

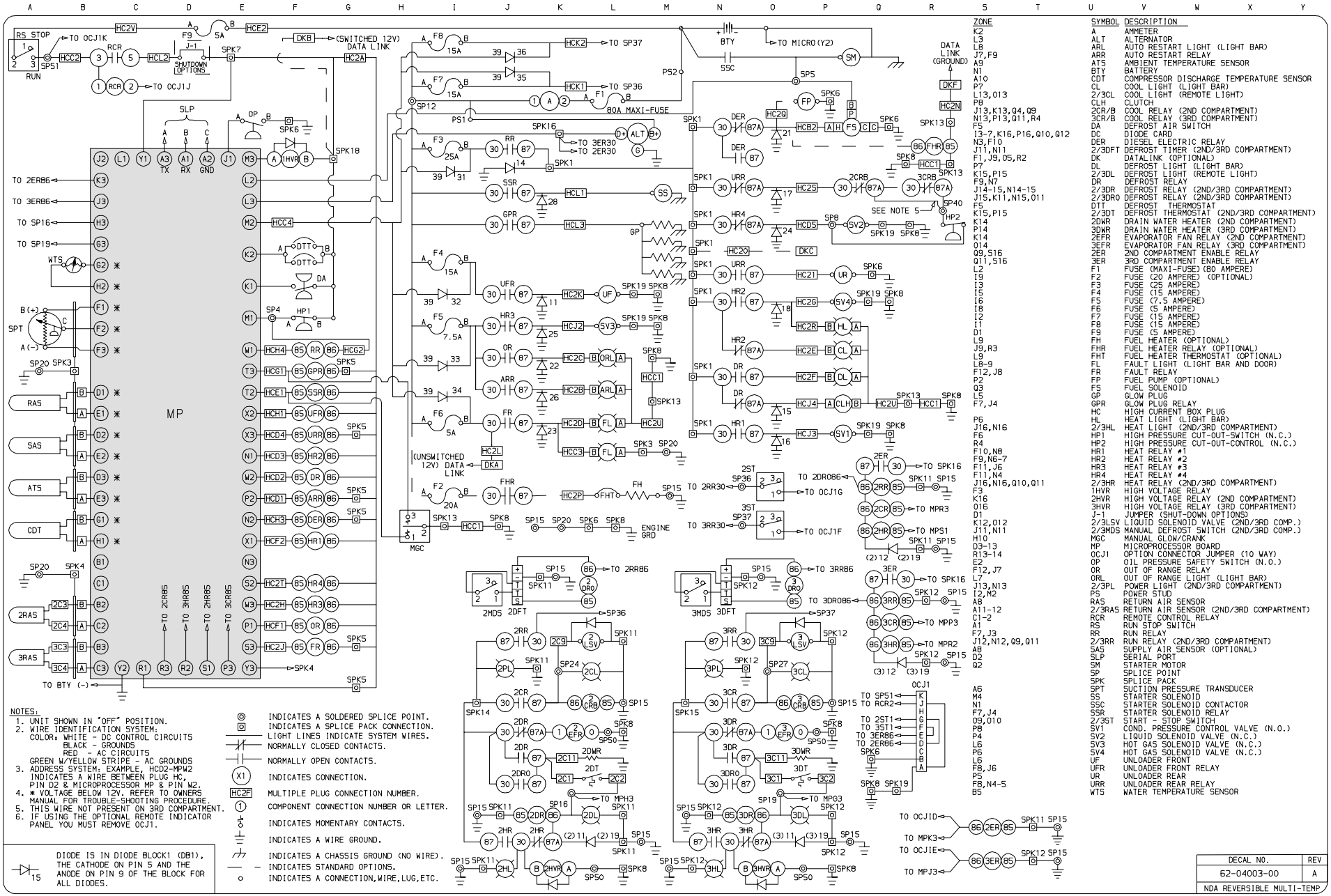


Figure 5-3. Electrical Schematic Wiring Diagram -- Dwg. No. 62-04003 -- NDA Starting with S/N FAC90391017 (Sheet 1 of 2)

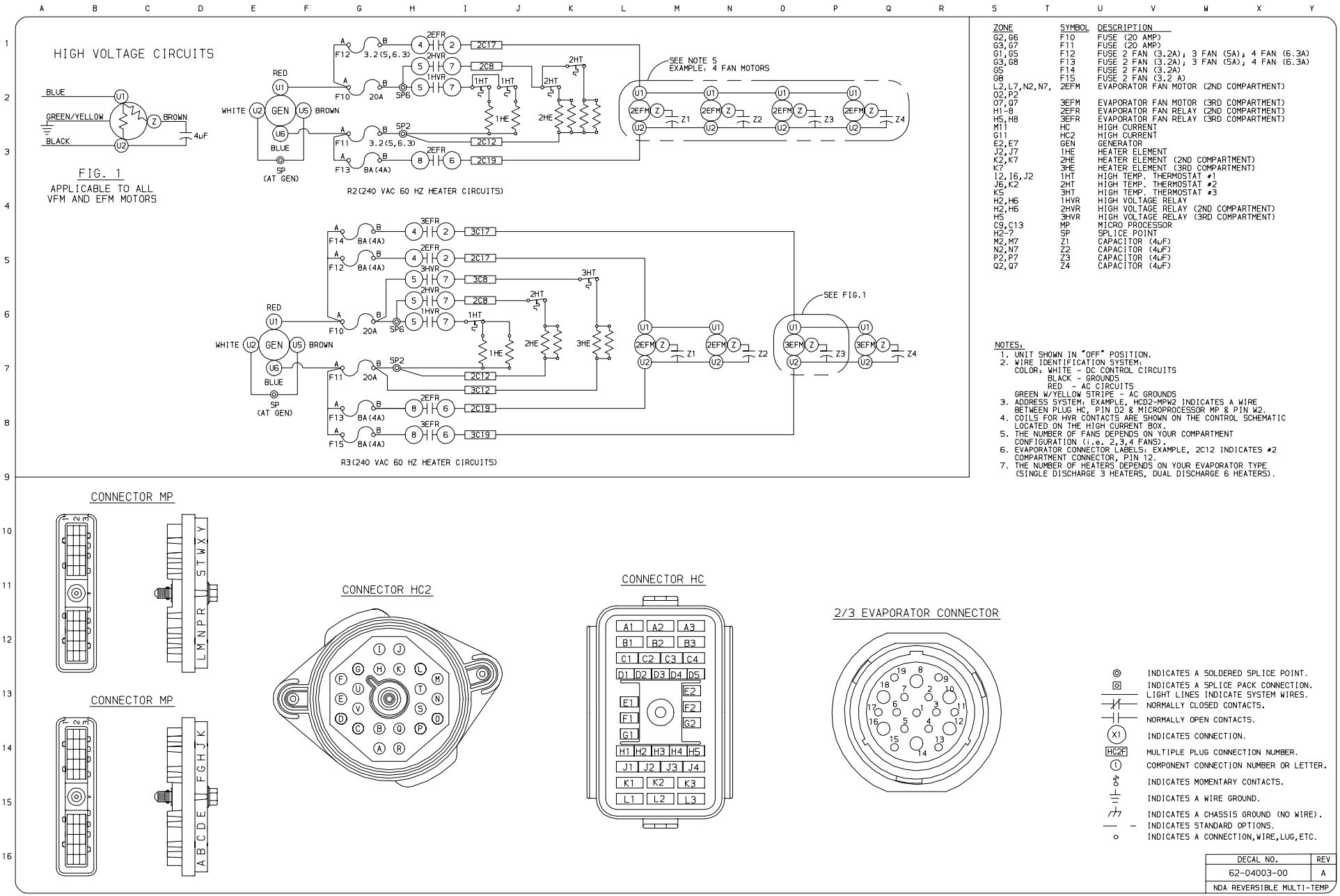


Figure 5-3. Electrical Schematic Wiring Diagram -- Dwg. No. 62-04003 -- NDA Starting with S/N FAC90391017 (Sheet 2 of 2)

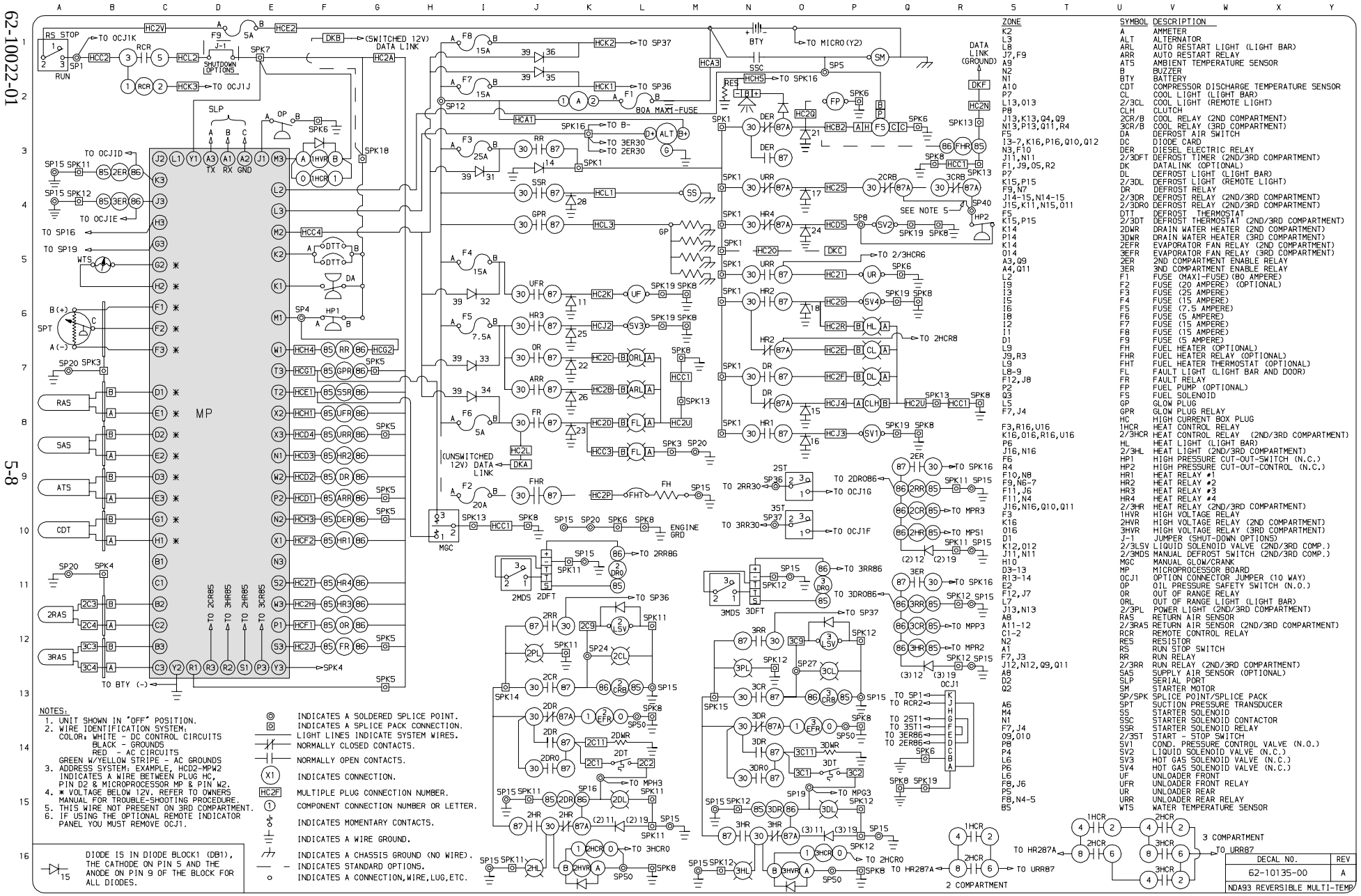


Figure 5-5. Electrical Schematic Wiring Diagram -- Dwg. No. 62-10135 -- NDA with R404A (Sheet 1 of 2)

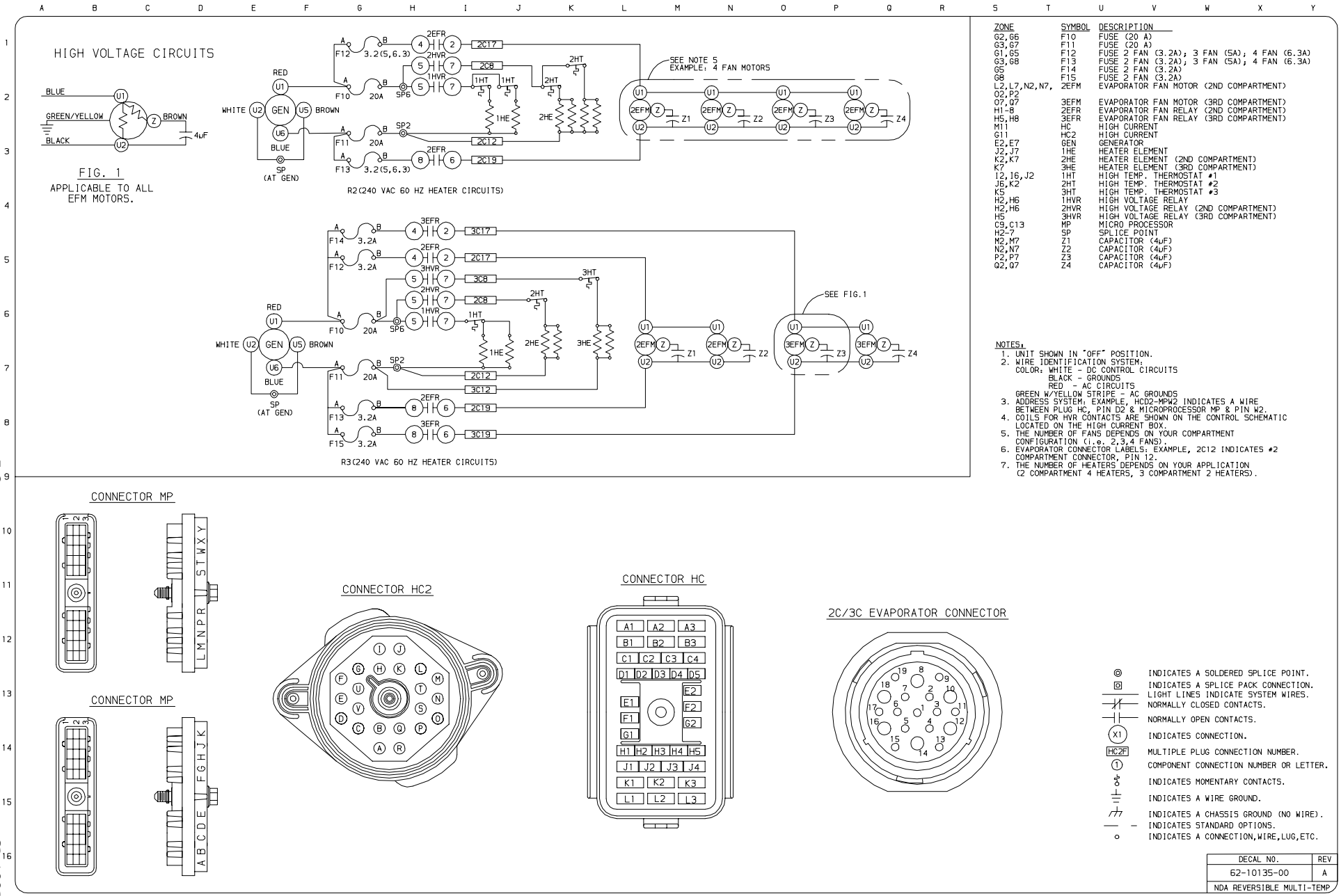


Figure 5-5. Electrical Schematic Wiring Diagram -- Dwg. No. 62-10135 -- NDA with R404A (Sheet 2 of 2)

SECTION 6

MODEL NDM UNITS WITH STANDBY MOTOR

6.1 MODEL NDM UNITS WITH STANDBY MOTOR

Table 6-1. Model Chart								
Models	Refrigerant				Compressor	Engine	Engine Speed rpm	
	R-22		R-404A					
	LB	KG	LB	KG			High	Low
NDM93– – –N	–	–	28	12.7	05G 37 cfm	CT4-134-TV or CT4-134-DI	1700	1350
NDM94– – –N	28	12.7	–	–				

EVAPORATORS			
Evaporator Models	Lane Size	Discharge	Number of Fans
MMS 1000-3	1	Single	3

a. Model NDM

The model NDM is similar to the model NDA except that it does not use the 5 kilowat, single phase generator. Instead, the unit is equipped with an electric motor that functions as an induction generator in diesel operation, and allows for electric standby operation. Also there is a standby motor contactor and a receptacle for a power plug.

The diesel engine drives the compressor directly through a centrifugal clutch, except during standby operation. During standby operation, the centrifugal clutch is disengaged from the compressor sheave. The compressor is then belt driven by the standby motor.

b. Remote Evaporator

There is only one remote evaporator used per compartment with model NDM. This evaporator has a single discharge, with 3 DC fan motors and electric heaters (See Figure 6-1).

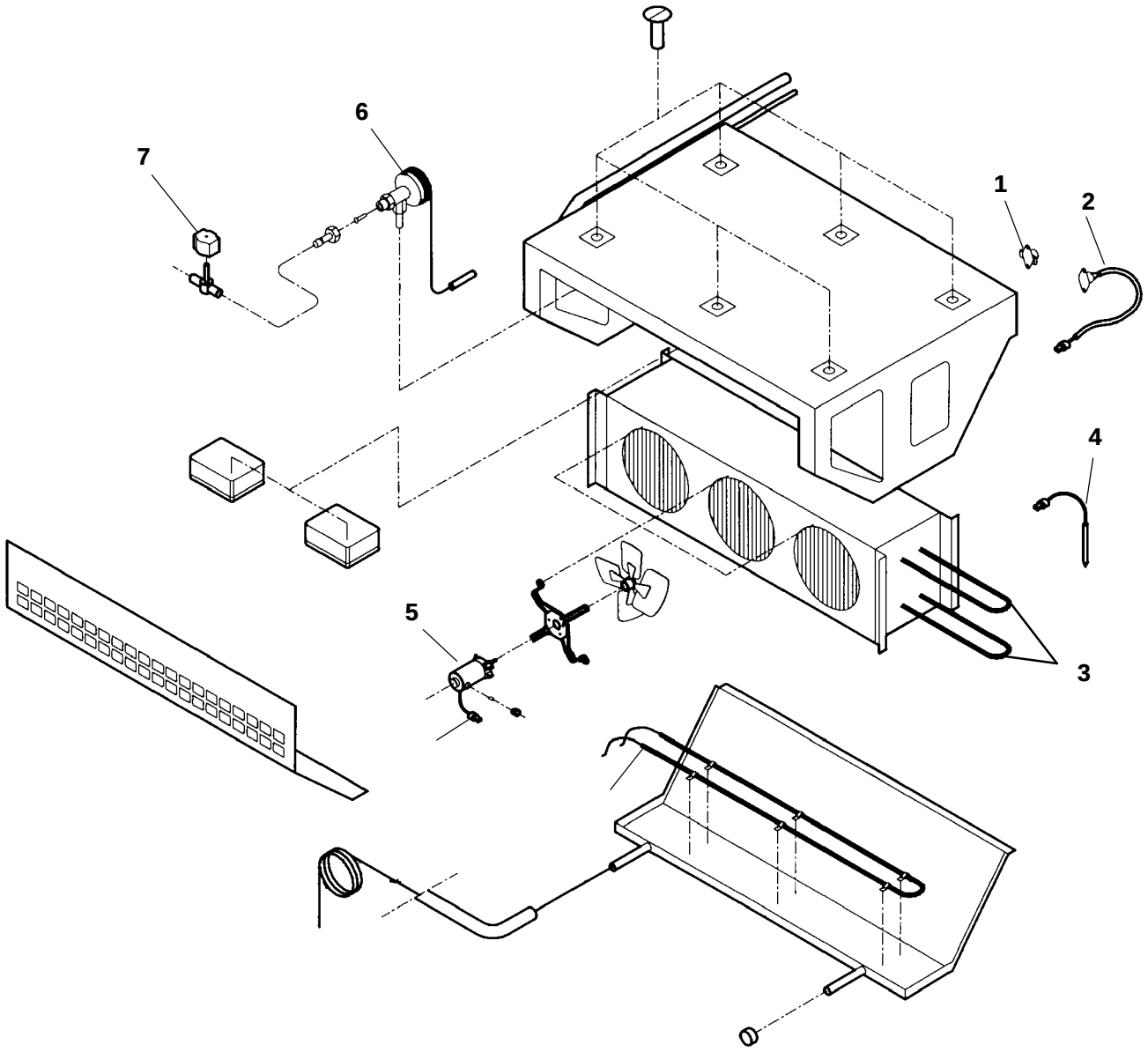
6.2 ELECTRICAL DATA

Electric Standby Motor 50 Hz	
Horsepower	9000 watts
Voltage	380 vac
Full load Amps	17.6
Speed	2935 rpm

Remote Evaporator Fan Motors	
Volts	12 vdc
Wattage	140 w
Speed	2500 rpm

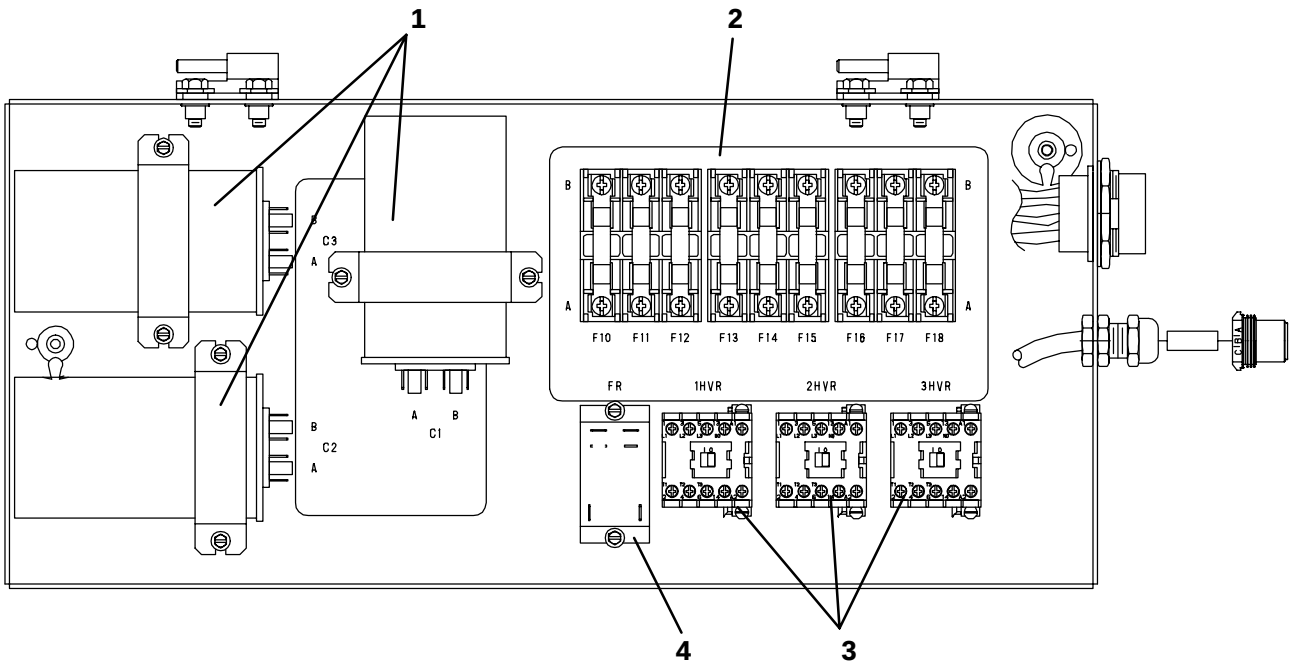
Host Evaporator Heaters -- Two Compartment		
	Diesel Operation	Electric Standby
Number	3	3
Voltage	470 vac	380 vac
Wattage	1500	950
Host Evaporator Heaters -- Three Compartment		
Number	3	3
Voltage	430 vac	380 vac
Wattage	750	475

Remote Evaporator Heaters -- Two Compartment		
	Diesel Operation	Electric Standby
Number	3	3
Voltage	470 vac	380 vac
Wattage	1750	1250
Remote Evaporator Heaters -- Three Compartment		
Number	3	3
Voltage	470 vac	380 vac
Wattage	875	625



1. Defrost Terminal Sensor
2. High Temperature Klixon
3. Heaters
4. Thermostat Sensor
5. Evaporator Fan Motor
6. Expansion Valve
7. Liquid Solenoid Valve (LSV)

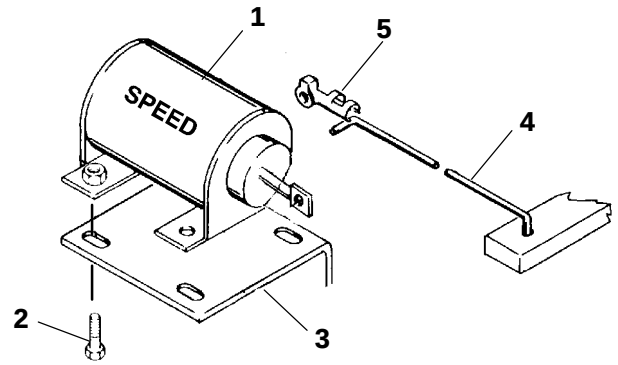
Figure 6-1. Remote Evaporator



1. Capacitor
2. Fuse 4 amp
3. Contactor
4. Relays 30 amp

Figure 6-2. High Voltage Control Box

6.3 SERVICING SPEED CONTROL SOLENOID AND LINKAGE



1. Solenoid
2. Bolt
3. Solenoid Bracket
4. Linkage (Speed)
5. Clip

Figure 6-3. Speed Control Solenoid

a. Disconnect wiring to solenoid. Disconnect linkage arm (item 6, Figure 6-3) from solenoid. Remove mounting hardware from solenoid and then remove solenoid.

b. Install replacement solenoid and mounting hardware. Do not tighten at this time.

c. Attach linkage to solenoid and install the clip to the linkage rod.

d. Hold the speed lever against the low speed stop and check the RPM's (Refer to Table 6-1). Adjust the low speed stop screw if necessary.

e. Check engine speed. With the engine stopped, place a mark on the crankshaft sheave (white paint for example). Speed may be verified by a Strobette model 964 (strobe-tachometer) Carrier Transicold P/N 07-00206.

f. Hold the speed lever against the high speed stop and check the RPM's (Refer to Table 1-1). Adjust the high speed stop screw if necessary.

g. Energize the speed solenoid. Push the solenoid so that the speed arm rests against the high speed stop screw and tighten solenoid mounting bolts. Connect wiring to solenoid.

6.4 STANDBY MOTOR V-BELTS (NDM)

NOTE

The standby motor V-belts are a matched set. Always replace both belt.

a. Remove V-belt guard.

b. Remove 6 bolts on rear face of clutch flange (See Figure 6-4).

c. Slide clutch flange forward inside clutch sheave.

d. Remove and replace V-belt through opening.

e. Adjust belt tension to 70 to 80. Install V-belt guard. DO NOT START UNIT UNTIL V-BELT GUARD IS INSTALLED.

f. Start unit and run for 10 minutes to allow for belt stretch.

g. Turn unit off and recheck belt tension.

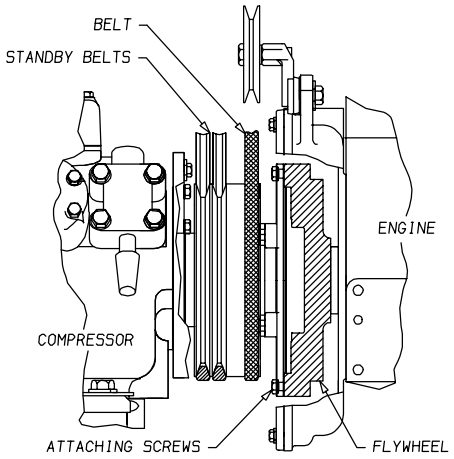


Figure A

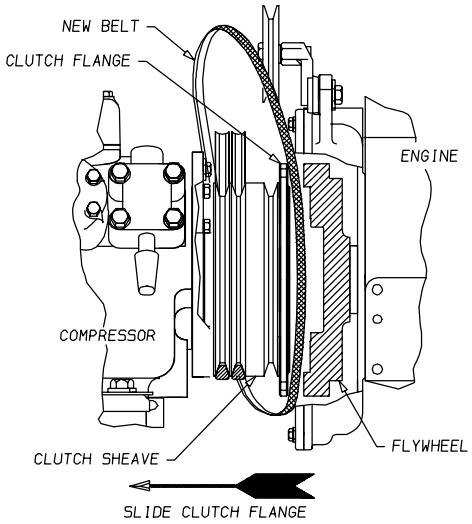


Figure B

Figure 6-4. Removing V-Belt from Clutch (NDM)

6.5 SERVICING STANDBY CLUTCH (NDM)

The clutch must be inspected if the clutch slips or grabs. The clutch automatically engages (clutch engagement 550 ¦ 50 rpm) during starting cycle of the engine as the engine accelerates to low speed. The clutch does not engage during standby motor operation.

a. Unplug unit from external electrical outlet and disconnect battery.

b. Remove the two rear compressor bracket mounting bolts (compressor shockmount end).

c. Block up engine.

d. Remove clutch V-belts as outlined in section 6.4.

e. Pump down the unit.

f. Remove suction and discharge service valve.

g. Attach sling or other device to the compressor.

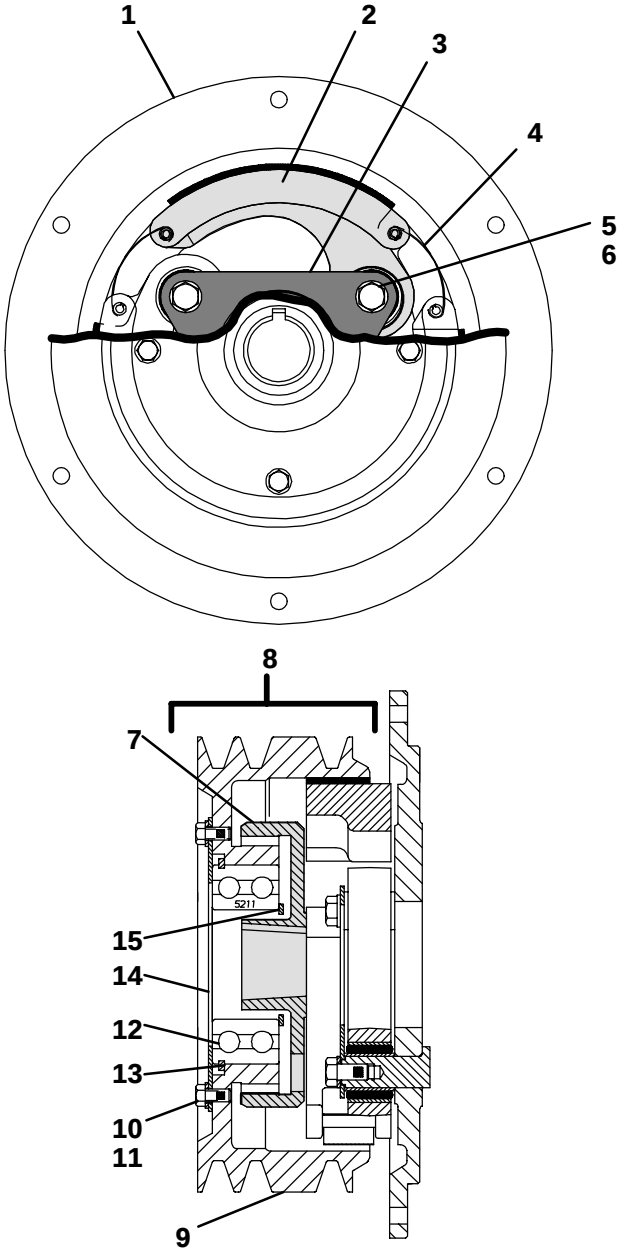
h. Slide compressor enough to remove clutch.

i. Remove (6) 5/16-18 capscrews from rotor assembly (Item 2, Figure 6-5).

j. Using 3 of the capscrews as jacking screws, remove the center section of the clutch housing. This will expose the snap ring holding the housing to the drive hub. Remove snap ring and housing.

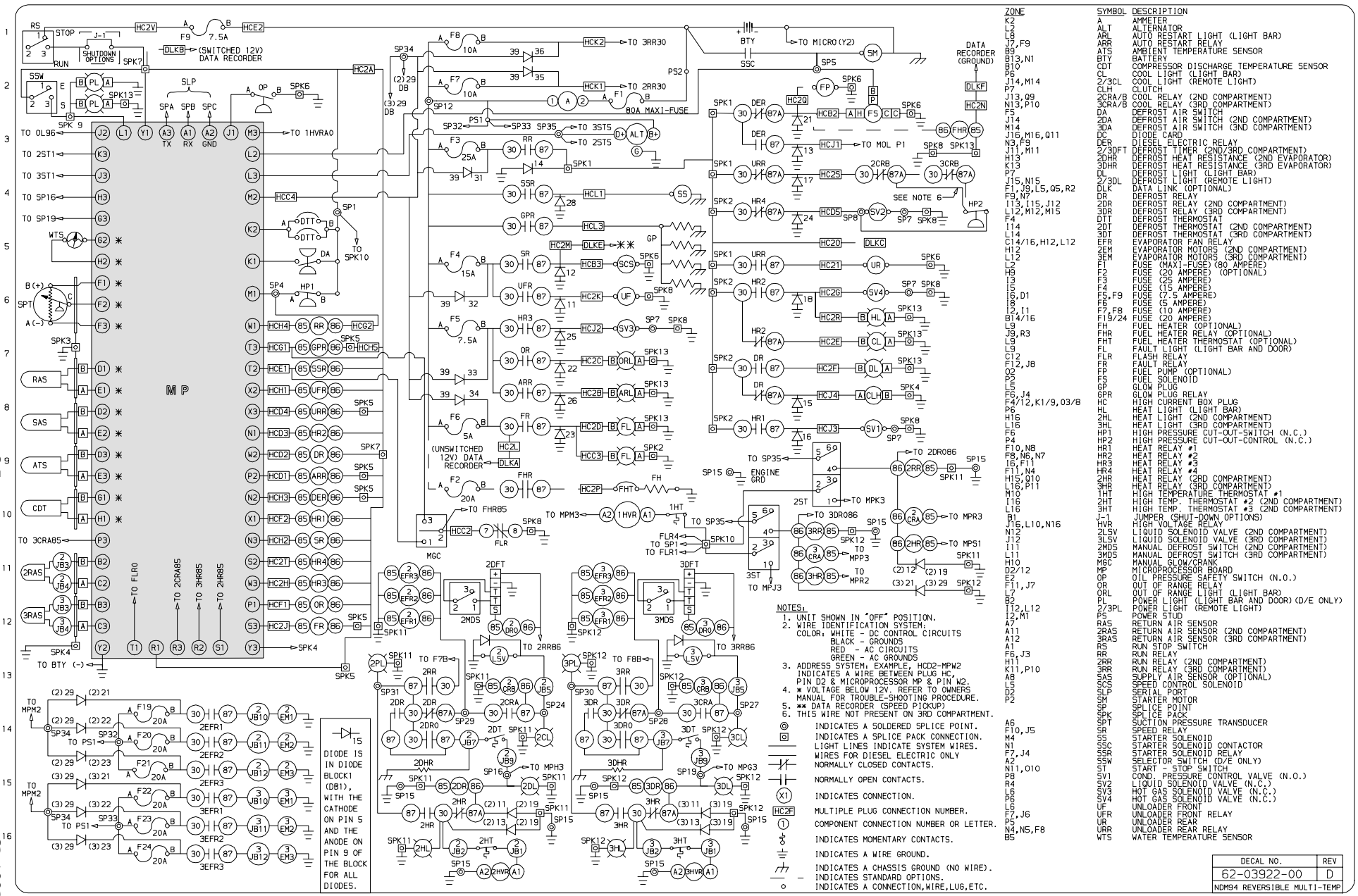
k. After replacing necessary parts, reassembly by reversing above steps. Install snap ring, painted side **must** face away from bearing.

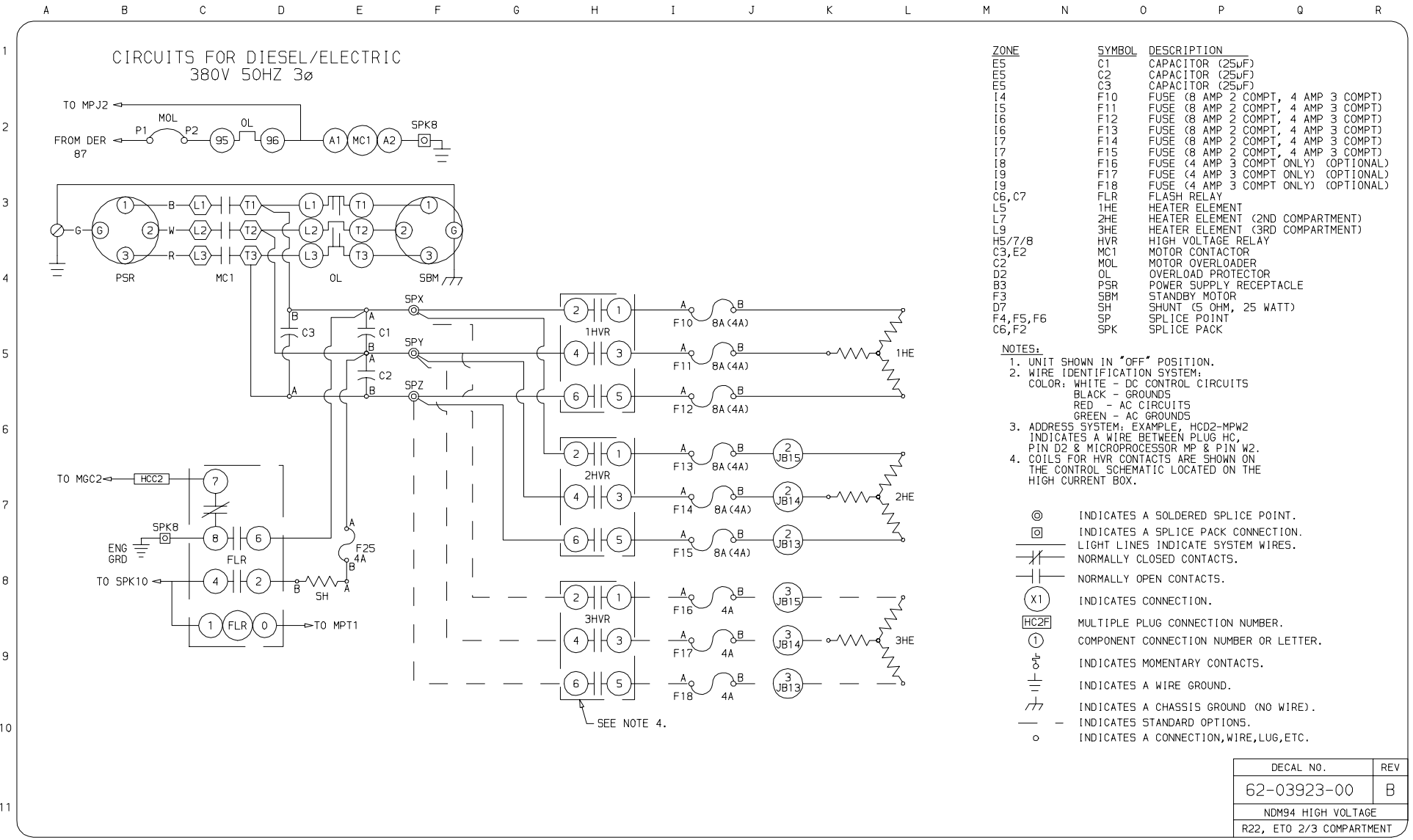
l. Start unit and check operation.



1. Rotor Plate
2. Friction Shoe
3. Delta Bridge
4. Spring, Leaf
5. Screw
6. Washer
7. Coupling, Adapter
8. Housing Assembly
9. Housing
10. Screw
11. Washer
12. Ball Bearing Assembly
13. Snap Ring
14. Retaining Plate
15. Snap Ring, External

Figure 6-5. Standby Clutch Assembly (NDM)


ZONE
SYMBOL DESCRIPTION
K2 A AMMETER
L2 ALT ALTERNATOR
L8 ARL AUTO RESTART LIGHT (LIGHT BAR)
J7,F9 ARR AUTO RESTART RELAY
B9 ATS AMBIENT TEMPERATURE SENSOR
B13,N1 BTY BATTERY
B10 CDT COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6 CL COOL LIGHT (LIGHT BAR)
J14,M14 2/3CL COOL LIGHT (REMOTE LIGHT)
P7 CLH CLUTCH
J13,Q9 2CRA/B COOL RELAY (2ND COMPARTMENT)
N13,P10 3CRA/B COOL RELAY (3RD COMPARTMENT)
F5 DA DEFROST AIR SWITCH
J14 2DA DEFROST AIR SWITCH (2ND COMPARTMENT)
M14 3DA DEFROST AIR SWITCH (3ND COMPARTMENT)
J16,M16,Q11 DC DIODE CARD
N3,F9 DER DIESEL ELECTRIC RELAY
J11,M11 2/3DFT DEFROST TIMER (2ND/3RD COMPARTMENT)
H13 2DHR DEFROST HEAT RESISTANCE (2ND EVAPORATOR)
K13 3DHR DEFROST HEAT RESISTANCE (3RD EVAPORATOR)
P7 DL DEFROST LIGHT (LIGHT BAR)
J15,N15 2/3DL DEFROST LIGHT (REMOTE LIGHT)
F1,J9,L5,Q5,R2 DLK DATA LINK (OPTIONAL)
F9,N7 DR DEFROST RELAY
I13,I15,J12 2DR DEFROST RELAY (2ND COMPARTMENT)
L12,M12,M15 3DR DEFROST RELAY (3RD COMPARTMENT)
F4 DTT DEFROST THERMOSTAT
I14 2DT DEFROST THERMOSTAT (2ND COMPARTMENT)
L14 3DT DEFROST THERMOSTAT (3RD COMPARTMENT)
C14/16,H12,L12 EFR EVAPORATOR FAN RELAY
H12 2EM EVAPORATOR MOTORS (2ND COMPARTMENT)
L12 3EM EVAPORATOR MOTORS (3RD COMPARTMENT)
L2 F1 FUSE (MAXI-FUSE)(80 AMPERE)
H9 F2 FUSE (20 AMPERE) (OPTIONAL)
I3 F3 FUSE (25 AMPERE)
I5 F4 FUSE (15 AMPERE)
I6,D1 F5,F9 FUSE (7.5 AMPERE)
I9 F6 FUSE (5 AMPERE)
I12,I1 F7,F8 FUSE (10 AMPERE)
B14/16 F19/24 FUSE (20 AMPERE)
L9 FH FUEL HEATER (OPTIONAL)
J9,R3 FHR FUEL HEATER RELAY (OPTIONAL)
L9 FHT FUEL HEATER THERMOSTAT (OPTIONAL)
L9 FL FAULT LIGHT (LIGHT BAR AND DOOR)
C12 FLR FLASH RELAY
F12,J8 FR FAULT RELAY
Q2 FP FUEL PUMP (OPTIONAL)
P2 FS FUEL SOLENOID
L5 GP GLOW PLUG
F6,J4 GPR GLOW PLUG RELAY
F4/12,K1/9,03/8 HC HIGH CURRENT BOX PLUG
P6 HL HEAT LIGHT (LIGHT BAR)
H16 2HL HEAT LIGHT (2ND COMPARTMENT)
L16 3HL HEAT LIGHT (3RD COMPARTMENT)
F6 HP1 HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
P4 HP2 HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N8 HR1 HEAT RELAY #1
F8,N6,N7 HR2 HEAT RELAY #2
I6,F11 HR3 HEAT RELAY #3
F11,N4 HR4 HEAT RELAY #4
I15,Q10 2HR HEAT RELAY (2ND COMPARTMENT)
L16,P11 3HR HEAT RELAY (3RD COMPARTMENT)
M10 1HT HIGH TEMPERATURE THERMOSTAT #1
I16 2HT HIGH TEMP. THERMOSTAT #2 (2ND COMPARTMENT)
L16 3HT HIGH TEMP. THERMOSTAT #3 (2ND COMPARTMENT)
B1 J-1 JUMPER (SHUT-DOWN OPTIONS)
J16,L10,N16 HVR HIGH VOLTAGE RELAY
N12 2LSV LIQUID SOLENOID VALVE (2ND COMPARTMENT)
J12 3LSV LIQUID SOLENOID VALVE (3RD COMPARTMENT)
I11 2MDS MANUAL DEFROST SWITCH (2ND COMPARTMENT)
L11 3MDS MANUAL DEFROST SWITCH (3RD COMPARTMENT)
H10 MGC MANUAL GLOW/CRANK
D2/12 MP MICROPROCESSOR BOARD
D2 OP OIL PRESSURE SAFETY SWITCH (N.O.)
F11,J7 OR OUT OF RANGE RELAY
L7 ORL OUT OF RANGE LIGHT (LIGHT BAR)
B2 PL POWER LIGHT (LIGHT BAR AND DOOR)(D/E ONLY)
I12,L12 2/3PL POWER LIGHT (REMOTE LIGHT)
I2,M1 PS POWER STUD
A7 RAS RETURN AIR SENSOR
A11 2RAS RETURN AIR SENSOR (2ND COMPARTMENT)
A12 3RAS RETURN AIR SENSOR (3RD COMPARTMENT)
A1 RS RUN STOP SWITCH
F6,J3 RR RUN RELAY
H11 2RR RUN RELAY (2ND COMPARTMENT)
K11,P10 3RR RUN RELAY (3RD COMPARTMENT)
A8 SAS SUPPLY AIR SENSOR (OPTIONAL)
L5 SCS SPEED CONTROL SOLENOID
D2 SLP SERIAL PORT
P2 SM STARTER MOTOR
SP SPLICE POINT
SPK SPLICE PACK
A6 SPT SUCTION PRESSURE TRANSDUCER
F10,J5 SR SPEED RELAY
M4 SS STARTER SOLENOID
N1 SSC STARTER SOLENOID CONTACTOR
F7,J4 SSR STARTER SOLENOID RELAY
A2 SSW SELECTOR SWITCH (D/E ONLY)
N11,O10 ST START - STOP SWITCH
P8 SV1 COND. PRESSURE CONTROL VALVE (N.O.)
R4 SV2 LIQUID SOLENOID VALVE (N.C.)
L6 SV3 HOT GAS SOLENOID VALVE (N.C.)
P6 SV4 HOT GAS SOLENOID VALVE (N.C.)
L6 UF UNLOADER FRONT
F7,J6 UFR UNLOADER FRONT RELAY
P5 UR UNLOADER REAR
N4,N5,F8 URR UNLOADER REAR RELAY
B5 WTS WATER TEMPERATURE SENSOR
NOTES:
1. UNIT SHOWN IN "OFF" POSITION.
2. WIRE IDENTIFICATION SYSTEM:
COLOR: WHITE - DC CONTROL CIRCUITS
BLACK - GROUNDS
RED - AC CIRCUITS
GREEN - AC GROUNDS
3. ADDRESS SYSTEM; EXAMPLE, HCD2-MPW2
INDICATES A WIRE BETWEEN PLUG HC,
PIN D2 & MICROPROCESSOR MP & PIN W2.
4. ✱ VOLTAGE BELOW 12V. REFER TO OWNERS MANUAL FOR TROUBLE-SHOOTING PROCEDURE.
5. ✱✱ DATA RECORDER (SPEED PICKUP)
6. THIS WIRE NOT PRESENT ON 3RD COMPARTMENT.
INDICATES A SOLDERED SPLICE POINT.
INDICATES A SPLICE PACK CONNECTION.
LIGHT LINES INDICATE SYSTEM WIRES.
WIRES FOR DIESEL ELECTRIC ONLY
NORMALLY CLOSED CONTACTS.
NORMALLY OPEN CONTACTS.
(X1) INDICATES CONNECTION.
HC2F MULTIPLE PLUG CONNECTION NUMBER.
(1) COMPONENT CONNECTION NUMBER OR LETTER.
INDICATES MOMENTARY CONTACTS.
INDICATES A WIRE GROUND.
INDICATES A CHASSIS GROUND (NO WIRE).
INDICATES STANDARD OPTIONS.
INDICATES A CONNECTION,WIRE,LUG,ETC.
DIODE IS IN DIODE BLOCK1 (DB1), WITH THE CATHODE ON PIN 5 AND THE ANODE ON PIN 9 OF THE BLOCK FOR ALL DIODES.
DECAL NO. 62-03922-00 REV D
NDM94 REVERSIBLE MULTI-TEMP
MP
RAS
SAS
ATS
CDT
2RAS
3RAS
DATA RECORDER (GROUND)
ENGINE GRD
MGC
2DFT
3DFT
2MDS
3MDS
2RR86
3RR86
TO MICRO(Y2)
TO 1HVRA0
TO 0L96
TO 2ST1
TO 3ST1
TO SP16
TO SP19
TO BTY (-)
TO FLR0
TO 2CRA85
TO 3HR85
TO 2HR85
TO MPM2
TO PS1
TO MPH3
TO MPG3
TO MOL P1
TO 3RR30
TO 2RR30
80A MAXI-FUSE
SEE NOTE 6
(UNSWITCHED 12V) DATA RECORDER
TO 2DR086
TO 3DR086
TO MPK3
TO MPR3
TO MPS1
TO MPR2
TO MPJ3
TO SP35
TO FHR85
TO F7B
TO F8B
TO 3RR85
TO 2RR85
TO 3HR85
TO 2HR85
TO 2CRA85
TO FLR0
TO BTY (-)
TO SP4
TO SP5
TO SP10
TO SP1
TO SP34
TO SP35
TO SP15
TO SP12
TO SP11
TO SP7
TO SP8
TO SP9
TO SP6
TO SP3
TO SP2



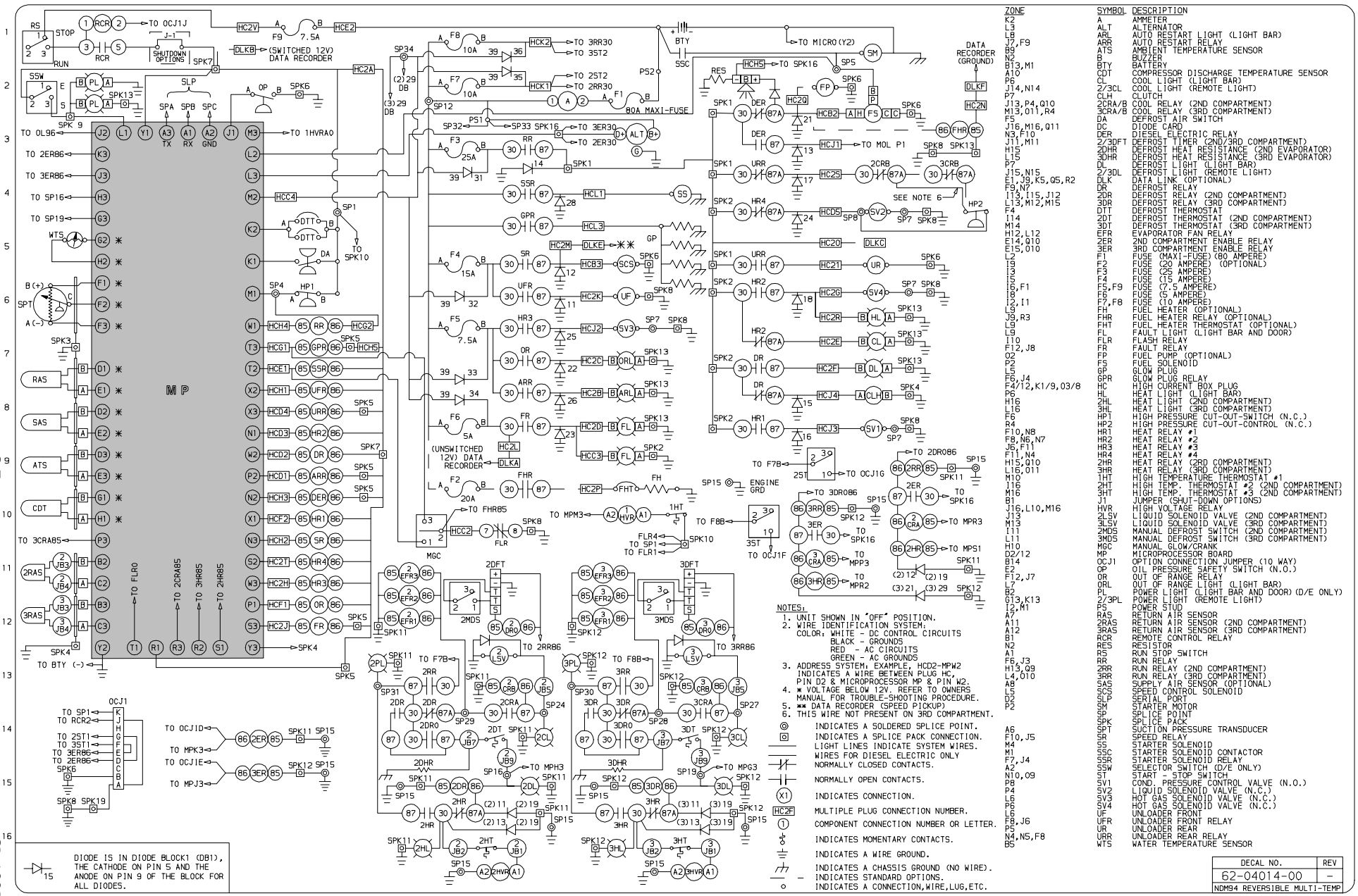
ZONE	SYMBOL	DESCRIPTION
E5	C1	CAPACITOR (25µF)
E5	C2	CAPACITOR (25µF)
E5	C3	CAPACITOR (25µF)
I4	F10	FUSE (8 AMP 2 COMPT, 4 AMP 3 COMPT)
I5	F11	FUSE (8 AMP 2 COMPT, 4 AMP 3 COMPT)
I6	F12	FUSE (8 AMP 2 COMPT, 4 AMP 3 COMPT)
I6	F13	FUSE (8 AMP 2 COMPT, 4 AMP 3 COMPT)
I7	F14	FUSE (8 AMP 2 COMPT, 4 AMP 3 COMPT)
I7	F15	FUSE (8 AMP 2 COMPT, 4 AMP 3 COMPT)
I8	F16	FUSE (4 AMP 3 COMPT ONLY) (OPTIONAL)
I9	F17	FUSE (4 AMP 3 COMPT ONLY) (OPTIONAL)
I9	F18	FUSE (4 AMP 3 COMPT ONLY) (OPTIONAL)
C6,C7	FLR	FLASH RELAY
L5	1HE	HEATER ELEMENT
L7	2HE	HEATER ELEMENT (2ND COMPARTMENT)
L9	3HE	HEATER ELEMENT (3RD COMPARTMENT)
H5/7/8	HVR	HIGH VOLTAGE RELAY
C3,E2	MC1	MOTOR CONTACTOR
C2	MOL	MOTOR OVERLOADER
D2	OL	OVERLOAD PROTECTOR
B3	PSR	POWER SUPPLY RECEPTACLE
F3	SBM	STANDBY MOTOR
D7	SH	SHUNT (5 OHM, 25 WATT)
F4,F5,F6	SP	SPLICE POINT
C6,F2	SPK	SPLICE PACK

NOTES:
1. UNIT SHOWN IN "OFF" POSITION.
2. WIRE IDENTIFICATION SYSTEM:
   COLOR: WHITE - DC CONTROL CIRCUITS
   BLACK - GROUNDS
   RED - AC CIRCUITS
   GREEN - AC GROUNDS
3. ADDRESS SYSTEM: EXAMPLE, HCD2-MPW2
   INDICATES A WIRE BETWEEN PLUG HC,
   PIN D2 & MICROPROCESSOR MP & PIN W2.
4. COILS FOR HVR CONTACTS ARE SHOWN ON
   THE CONTROL SCHEMATIC LOCATED ON THE
   HIGH CURRENT BOX.

- ◎ INDICATES A SOLDERED SPLICE POINT.
- ⊡ INDICATES A SPLICE PACK CONNECTION.
- LIGHT LINES INDICATE SYSTEM WIRES.
- NORMALLY CLOSED CONTACTS.
- NORMALLY OPEN CONTACTS.
- (X1) INDICATES CONNECTION.
- [HC2F] MULTIPLE PLUG CONNECTION NUMBER.
- (1) COMPONENT CONNECTION NUMBER OR LETTER.
- INDICATES MOMENTARY CONTACTS.
- INDICATES A WIRE GROUND.
- INDICATES A CHASSIS GROUND (NO WIRE).
- INDICATES STANDARD OPTIONS.
- INDICATES A CONNECTION,WIRE,LUG,ETC.

DECAL NO.	REV
62-03923-00	B
NDM94 HIGH VOLTAGE	
R22, ETO 2/3 COMPARTMENT	

Figure 6-7. Electrical Schematic Wiring Diagram -- Dwg. No. 62-03923 -- NDM


ZONE SYMBOL DESCRIPTION
K2 A AMMETER
L3 ALT ALTERNATOR
L3 ARL AUTO RESTART LIGHT (LIGHT BAR)
J7,F9 ARR AUTO RESTART RELAY
B9 ATS AMBIENT TEMPERATURE SENSOR
N2 B BUZZER
B13,M1 BTY BATTERY
A10 CDT COMPRESSOR DISCHARGE TEMPERATURE SENSOR
P6 CL COOL LIGHT (LIGHT BAR)
J14,N14 2/3CL COOL LIGHT (REMOTE LIGHT)
P7 CLH CLUTCH
J13,P4,Q10 2CRA/B COOL RELAY (2ND COMPARTMENT)
M13,O11,R4 3CRA/B COOL RELAY (3RD COMPARTMENT)
F5 DA DEFROST AIR SWITCH
J16,M16,Q11 DC DIODE CARD
N3,F10 DER DIESEL ELECTRIC RELAY
J11,M11 2/3DFT DEFROST TIMER (2ND/3RD COMPARTMENT)
H15 2DHR DEFROST HEAT RESISTANCE (2ND EVAPORATOR)
L15 3DHR DEFROST HEAT RESISTANCE (3RD EVAPORATOR)
P7 DL DEFROST LIGHT (LIGHT BAR)
J15,N15 2/3DL DEFROST LIGHT (REMOTE LIGHT)
E1,J9,K5,Q5,R2 DLK DATA LINK (OPTIONAL)
F9,N7 DR DEFROST RELAY
I13,I15,J12 2DR DEFROST RELAY (2ND COMPARTMENT)
L13,M12,M15 3DR DEFROST RELAY (3RD COMPARTMENT)
F4 DTT DEFROST THERMOSTAT
I14 2DT DEFROST THERMOSTAT (2ND COMPARTMENT)
M14 3DT DEFROST THERMOSTAT (3RD COMPARTMENT)
H12,L12 EFR EVAPORATOR FAN RELAY
E14,Q10 2ER 2ND COMPARTMENT ENABLE RELAY
E15,O10 3ER 3RD COMPARTMENT ENABLE RELAY
L2 F1 FUSE (MAXI-FUSE) (80 AMPERE)
I9 F2 FUSE (20 AMPERE) (OPTIONAL)
I3 F3 FUSE (25 AMPERE)
I5 F4 FUSE (15 AMPERE)
I6,F1 F5,F9 FUSE (7.5 AMPERE)
I8 F6 FUSE (5 AMPERE)
I2,I1 F7,F8 FUSE (10 AMPERE)
L9 FH FUEL HEATER (OPTIONAL)
J9,R3 FHR FUEL HEATER RELAY (OPTIONAL)
L9 FHT FUEL HEATER THERMOSTAT (OPTIONAL)
L9 FL FAULT LIGHT (LIGHT BAR AND DOOR)
I10 FLR FLASH RELAY
F12,J8 FR FAULT RELAY
O2 FP FUEL PUMP (OPTIONAL)
P2 FS FUEL SOLENOID
L5 GP GLOW PLUG
F6,J4 GPR GLOW PLUG RELAY
F4?12,K1/9,03/8 HC HIGH CURRENT BOX PLUG
P6 HL HEAT LIGHT (LIGHT BAR)
H16 2HL HEAT LIGHT (2ND COMPARTMENT)
L16 3HL HEAT LIGHT (3RD COMPARTMENT)
F6 HP1 HIGH PRESSURE CUT-OUT-SWITCH (N.C.)
R4 HP2 HIGH PRESSURE CUT-OUT-CONTROL (N.C.)
F10,N8 HR1 HEAT RELAY #1
F8,N6,N7 HR2 HEAT RELAY #2
J6,F11 HR3 HEAT RELAY #3
F11,N4 HR4 HEAT RELAY #4
H15,Q10 2HR HEAT RELAY (2RD COMPARTMENT)
L16,O11 3HR HEAT RELAY (3RD COMPARTMENT)
M10 1HT HIGH TEMPERATURE THERMOSTAT #1
J16 2HT HIGH TEMP. THERMOSTAT #2 (2ND COMPARTMENT)
M16 3HT HIGH TEMP. THERMOSTAT #3 (2ND COMPARTMENT)
B1 J1 JUMPER (SHUT-DOWN OPTIONS)
J16,L10,M16 HVR HIGH VOLTAGE RELAY
J13 2LSV LIQUID SOLENOID VALVE (2ND COMPARTMENT)
M13 3LSV LIQUID SOLENOID VALVE (3RD COMPARTMENT)
I11 2MDS MANUAL DEFROST SWITCH (2ND COMPARTMENT)
L11 3MDS MANUAL DEFROST SWITCH (3RD COMPARTMENT)
H10 MGC MANUAL GLOW/CRANK
D2/12 MP MICROPROCESSOR BOARD
B14 OCJ1 OPTION CONNECTION JUMPER (10 WAY)
E2 OP OIL PRESSURE SAFETY SWITCH (N.O.)
F12,J7 OR OUT OF RANGE RELAY
L7 ORL OUT OF RANGE LIGHT (LIGHT BAR)
B2 PL POWER LIGHT (LIGHT BAR AND DOOR) (D/E ONLY)
G13,K13 2/3PL POWER LIGHT (REMOTE LIGHT)
J2,M1 PS POWER STUD
A7 RAS RETURN AIR SENSOR
A11 2RAS RETURN AIR SENSOR (2ND COMPARTMENT)
A12 3RAS RETURN AIR SENSOR (3RD COMPARTMENT)
B1 RCR REMOTE CONTROL RELAY
N2 RES RESISTOR
A1 RS RUN STOP SWITCH
F6,J3 RR RUN RELAY
H13,O9 2RR RUN RELAY (2ND COMPARTMENT)
L4,O10 3RR RUN RELAY (3RD COMPARTMENT)
A8 SAS SUPPLY AIR SENSOR (OPTIONAL)
L5 SCS SPEED CONTROL SOLENOID
D2 SLP SERIAL PORT
P2 SM STARTER MOTOR
SP SPLICE POINT
SPK SPLICE PACK
A6 SPT SUCTION PRESSURE TRANSDUCER
F10,J5 SR SPEED RELAY
M4 SS STARTER SOLENOID
M1 SSC STARTER SOLENOID CONTACTOR
F7,J4 SSR STARTER SOLENOID RELAY
A2 SSW SELECTOR SWITCH (D/E ONLY)
N10,O9 ST START - STOP SWITCH
P8 5V1 COND. PRESSURE CONTROL VALVE (N.O.)
P4 5V2 LIQUID SOLENOID VALVE (N.C.)
L6 5V3 HOT GAS SOLENOID VALVE (N.C.)
P6 5V4 HOT GAS SOLENOID VALVE (N.C.)
L6 UF UNLOADER FRONT
F8,J6 UFR UNLOADER FRONT RELAY
P5 UR UNLOADER REAR
N4,N5,F8 URR UNLOADER REAR RELAY
B5 WTS WATER TEMPERATURE SENSOR
NOTES:
1. UNIT SHOWN IN "OFF" POSITION.
2. WIRE IDENTIFICATION SYSTEM:
COLOR: WHITE - DC CONTROL CIRCUITS
BLACK - GROUNDS
RED - AC CIRCUITS
GREEN - AC GROUNDS
3. ADDRESS SYSTEM; EXAMPLE, HCD2-MPW2 INDICATES A WIRE BETWEEN PLUG HC, PIN D2 & MICROPROCESSOR MP & PIN W2.
4. * VOLTAGE BELOW 12V. REFER TO OWNERS MANUAL FOR TROUBLE-SHOOTING PROCEDURE.
5. ** DATA RECORDER (SPEED PICKUP)
6. THIS WIRE NOT PRESENT ON 3RD COMPARTMENT.
INDICATES A SOLDERED SPLICE POINT.
INDICATES A SPLICE PACK CONNECTION.
LIGHT LINES INDICATE SYSTEM WIRES.
WIRES FOR DIESEL ELECTRIC ONLY
NORMALLY CLOSED CONTACTS.
NORMALLY OPEN CONTACTS.
(X1) INDICATES CONNECTION.
HC2F MULTIPLE PLUG CONNECTION NUMBER.
(1) COMPONENT CONNECTION NUMBER OR LETTER.
INDICATES MOMENTARY CONTACTS.
INDICATES A WIRE GROUND.
INDICATES A CHASSIS GROUND (NO WIRE).
INDICATES STANDARD OPTIONS.
INDICATES A CONNECTION,WIRE,LUG,ETC.
DIODE IS IN DIODE BLOCK1 (DB1), THE CATHODE ON PIN 5 AND THE ANODE ON PIN 9 OF THE BLOCK FOR ALL DIODES.
DECAL NO. 62-04014-00 REV -
NDM94 REVERSIBLE MULTI-TEMP
MP
TO 1HVRA0
TO 2ER86
TO 3ER86
TO SP16
TO SP19
TO 0L96
RAS
SAS
ATS
CDT
2RAS
3RAS
TO BTY (-)
TO FLR0
TO 2CRA85
TO 3HR85
TO 2HR85
TO MICRO(Y2)
DATA RECORDER (GROUND)
TO SP10
TO MPM3
TO MPS3
TO MPS1
TO MPR3
TO MPR2
TO MPH3
TO MPG3
TO OCJ1G
TO OCJ1F
TO F7B
TO F8B
TO 2RR86
TO 3RR86
ENGINE GRD
SEE NOTE 6
TO MOL P1
TO 3RR30
TO 3ST2
TO 2ST2
TO 2RR30
TO 3ER30
TO 2ER30
80A MAXI-FUSE
(SWITCHED 12V) DATA RECORDER
(UNSWITCHED 12V) DATA RECORDER
TO FHR85
TO OCJ1D
TO OCJ1E
TO OCJ3
TO SP1
TO RCR2
TO 2ST1
TO 3ST1
TO 3ER86
TO 2ER86
TO MPK3
TO MPJ3
OCJ1
SHUTDOWN OPTIONS
J-1
SLP
SSW
TX
RX
GND
SPA
SPB
SPC
STOP
RUN
WTS
SPT
DA
DTT
OP
PL
FP
SM
SSC
BTY
RES
FHR
FH
GPR
GP
SR
UFR
OR
ARR
DER
FR
URR
UR
UF
SS
SSR
RR
2DFT
3DFT
2MDS
3MDS
2DR
3DR
2CRA
3CRA
2HR
3HR
2HT
3HT
2HL
3HL
2DT
3DT
2CL
3CL
2DHR
3DHR
2DR0
3DR0
2RR
3RR
2ER
3ER
2HVR
3HVR
1HT
3ST
FLR
FLR4
FLR1
TO SP1
MGC
SP1
SP4
SP5
SP6
SP7
SP8
SP10
SP11
SP12
SP15
SP16
SP19
SP24
SP27
SP28
SP29
SP30
SP31
SP32
SP33
SP34
PS1
PS2
HP1
HP2
SV1
SV2
SV3
SV4
SCS
DLKA
DLKB
DLKC
DLKE
DLKF
HCC2
HCC4
HCD1
HCD2
HCD3
HCD4
HCE1
HCE2
HCF1
HCF2
HCG1
HCG2
HCH1
HCH2
HCH4
HCH5
HCJ1
HCJ2
HCJ3
HCJ4
HCK1
HCK2
HCL1
HCL3
HCM2
HCN2
HCP2
HCQ2
HCR2
HCS2
HCT2
HCV2
HCW2
HCX2
HCY2
HCZ2
HC2A
HC2B
HC2C
HC2D
HC2E
HC2G
HC2K
HC2L
HC2M
HC2P
HC2R
HC2S
HC2V
HC20
HC21
2DR086
3DR086
2CR086
3CR086
2HR086
3HR086
2ER086
3ER086
2HR085
3HR085
2CR085
3CR085
2ER085
3ER085
2DR085
3DR085
2HL085
3HL085
2DT085
3DT085
2CL085
3CL085
2DR085
3DR085
2RR085
3RR085
2HT085
3HT085
2HVR085
3HVR085
2LSV085
3LSV085
2MDS085
3MDS085
2DHR085
3DHR085
2DR0085
3DR0085
2RR085
3RR085
2ER085
3ER085
2HVR085
3HVR085
2PL085
3PL085
2JB7085
3JB7085
2JB8085
3JB8085
2JB9085
3JB9085
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3JB2085
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2JB6085
3JB6

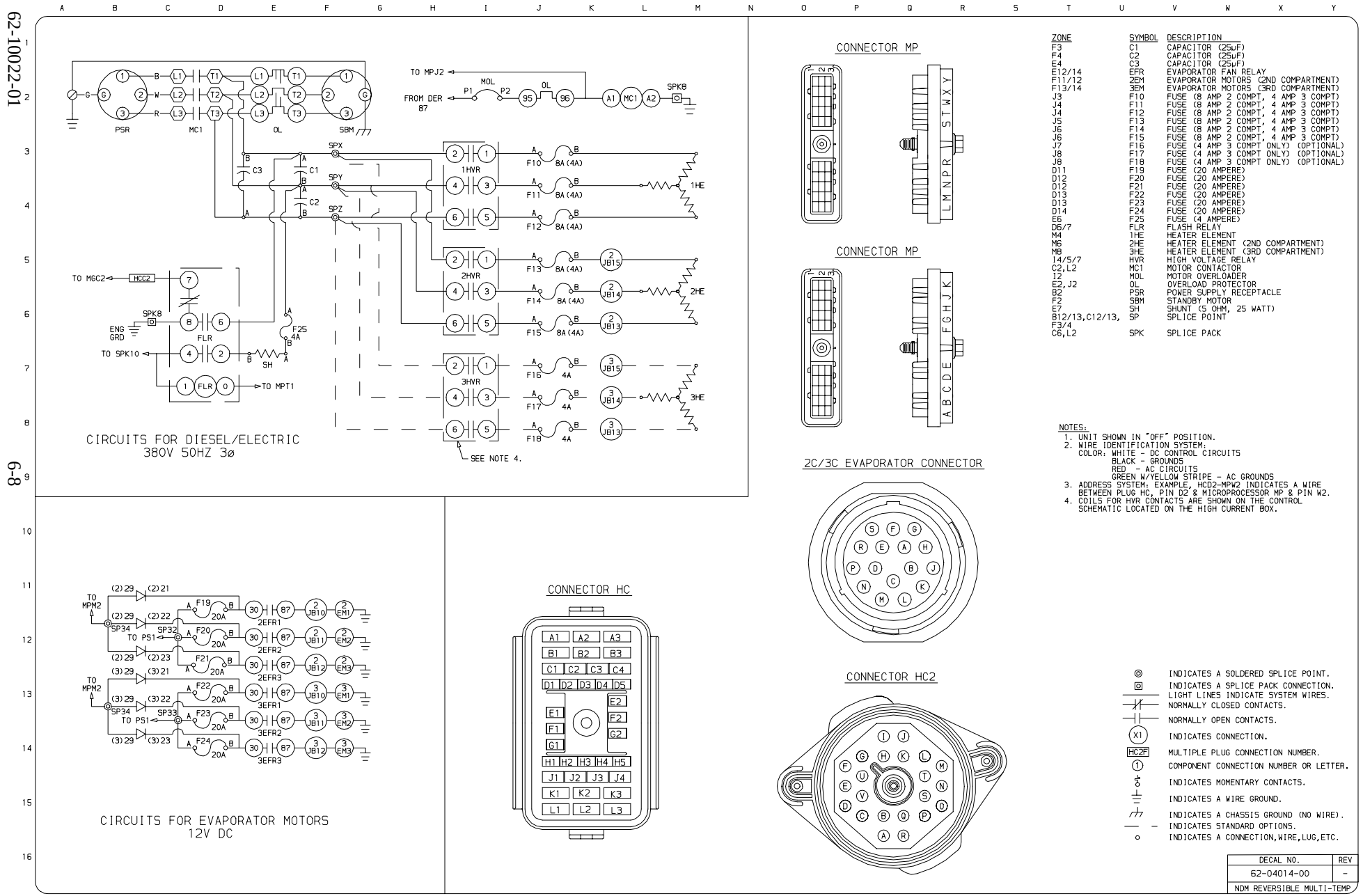

Figure 6-8. Electrical Schematic Wiring Diagram -- Dwg. No. 62-04014 -- NDM with Buzzer

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